

Title: Numerical Methods Lecture

Speakers: Dustin Lang

Collection: Numerical Methods 2023/24

Date: January 16, 2024 - 10:15 AM

URL: <https://pirsa.org/24010021>

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Linear Algebra 2.ipynb Gradient Descent.ipynb Congugate Gradients.ipynb Eigenvectors.ipynb

Julia 1.10.0

```
[1]: using LinearAlgebra

[2]: """
      x = gradient_descent(A, b, n)

Use gradient descent (a rather inefficient method) to approximate the solution of `A*x=b`
using `n` iterations.
"""
function gradient_descent(A, b, n)
    x0 = A \ b
    x = zero(b)
    for i in 1:n
        r = b - A*x
        println("iter $i  |e|=$(norm(x-x0))  |r|=$(norm(r))")
        # x1 = x + α*r
        # min!(|b - A*x1|^2)
        # min!(|r - α*A*r|^2)
        # solve!((r - α*A*r)' * (A*r))
        s = A * r
        α = (r' * s) / (s' * s)
```

Simple 0 4 Julia 1.10.0 | Idle Mode: Command Ln 3, Col 8 Gradient Descent.ipynb

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Linear Algebra 2.ipynb Gradient Descent.ipynb Congugate Gradients.ipynb Eigenvectors.ipynb

Code Julia 1.10.0

```

# min!(|b - A*x|^2)
# min!(|r - α*A*r|^2)
# solve!((r - α*A*r)' * (A*r))
s = A * r
α = (r' * s) / (s' * s)
x += α * r

end
return x
end

```

[2]: gradient_descent

[3]: A = randn(10, 10)
 A = A + A'
 A = A*A

[3]: 10×10 Matrix{Float64}:
 31.085 8.80099 -7.22036 ... 4.44075 3.30729 3.0609
 8.80099 11.7012 -3.96008 -0.433471 -1.84626 6.18429
 -7.22036 -3.96008 42.3542 -4.59445 0.783553 -17.0228
 1.33746 1.55973 9.75757 3.85878 -1.96274 2.77541
 14.2005 11.6704 2.22556 2.86072 5.20206 2.88001

Simple 0 \$ 4 Julia 1.10.0 | Idle Mode: Edit Ln 10, Col 17 Gradient Descent.ipynb

```
[6]: x = gradient_descent(A, b, 20)
      norm(x - x0), norm(b - A*x)
```

iter 1	e =3.201349644008161	r =1.066780544032526
iter 2	e =3.192715397577798	r =0.5809169134923685
iter 3	e =3.180897439694364	r =0.5087606598711178
iter 4	e =3.168986257811709	r =0.48206700276467856
iter 5	e =3.1563217421463885	r =0.4670217875150276
iter 6	e =3.143922587446365	r =0.45725667284926247
iter 7	e =3.130947937429802	r =0.450407509440478
iter 8	e =3.1182960296600246	r =0.445300154746874
iter 9	e =3.1050550868916025	r =0.44124886663080043
iter 10	e =3.0921890889783796	r =0.437853713326544
iter 11	e =3.0787719182218445	r =0.4348670141983182
iter 12	e =3.065811614152817	r =0.43214324093088413
iter 13	e =3.0523543969539095	r =0.4295912245550948
iter 14	e =3.0394102149496933	r =0.4271576301635707
iter 15	e =3.0260033989715476	r =0.4248086664846064
iter 16	e =3.0131335484379047	r =0.4225242679576549
iter 17	e =2.999817992973106	r =0.42029129511651897
iter 18	e =2.9870460337660285	r =0.4181015587380413
iter 19	e =2.9738370756726655	r =0.41594033327698274

Linear Algebra 2.ipynb Gradient Descent.ipynb Congugate Gradients.ipynb Eigenvectors.ipynb

Code Julia 1.10.0

```
iter 82 |e|=2.2612154868551575 |r|=0.3121982249199158  
iter 83 |e|=2.251216877397466 |r|=0.3108370535430143  
iter 84 |e|=2.241631693941965 |r|=0.3094821646333743  
iter 85 |e|=2.231719688683158 |r|=0.30813350821073965  
iter 86 |e|=2.2222175306194987 |r|=0.30679103665941587  
iter 87 |e|=2.2123913783164038 |r|=0.3054547030408289  
iter 88 |e|=2.202971525210055 |r|=0.3041244625206773  
iter 89 |e|=2.1932304812801644 |r|=0.30280027087531236  
iter 90 |e|=2.1838922191090315 |r|=0.30148208575485747  
iter 91 |e|=2.174235545551566 |r|=0.3001698653612108  
iter 92 |e|=2.164978166627645 |r|=0.2988635695659155  
iter 93 |e|=2.1554051319484495 |r|=0.29756315874011907  
iter 94 |e|=2.146227934843378 |r|=0.2962685947438464  
iter 95 |e|=2.136737813983117 |r|=0.2949798398904983  
iter 96 |e|=2.1276401034570975 |r|=0.29369685782224964  
iter 97 |e|=2.118232177722309 |r|=0.2924196125936746  
iter 98 |e|=2.109213264655952 |r|=0.29114806944633803  
iter 99 |e|=2.0998868216525763 |r|=0.28988219399785703  
iter 100 |e|=2.090946022981325 |r|=0.28862195292727094
```

[7]: (2.0817003565504, 0.2873673132574228)

```
[2]: .....  
      x = gradient_descent(A, b, n)  
  
Use gradient descent (a rather inefficient method) to approximate the solution of `A*x=b`  
using `n` iterations.  
.....  
function gradient_descent(A, b, n)  
    x0 = A \ b  
    x = zero(b)  
    for i in 1:n  
        r = b - A*x  
        println("iter $i  |e|=$(norm(x-x0))  |r|=$(norm(r))")  
        # x1 = x + α*r  
        # min!(|b - A*x1|^2)  
        # min!(|r - α*A*r|^2)  
        # solve!((r - α*A*r)' * (A*r))  
        s = A * r  
        α = (r' * s) / (s' * s)  
        x += α * r  
    end  
    return x
```

```
[7]: using LinearAlgebra

•[8]: function conjugate_gradients(A, b, n)
    x0 = A \ b
    x = zero(b)
    r = b - A*x
    s = r
    for i in 1:n
        println("iter $i |e|=$(norm(x-x0)) |r|=$(norm(r))")
        α = (r' * r) / (s' * A * s)
        x1 = x + α * s
        # r1 = r - α * A * s
        r1 = r - A * x1
        β1 = (r1' * r1) / (r' * r)
        s1 = r1 + β1 * s
        x = x1
        r = r1
        s = s1
    end
    return x
```

```
[12]: x = conjugate_gradients(A, b, 20)  
norm(x - x0), norm(b - A*x)
```

iter 1	e =1.5240527248013345	r =2.571259057047426=2.571259057047426
iter 2	e =1.4442834350134488	r =2.1481720201832615=2.148172020183261
iter 3	e =1.347371404189048	r =2.1658594947826195=2.16585949478262
iter 4	e =1.1836635039063552	r =1.8759364010727508=1.8759364010727515
iter 5	e =1.0035238752783366	r =1.35071614088406=1.35071614088406
iter 6	e =0.9353076959678551	r =0.752878345324781=0.752878345324781
iter 7	e =0.7391034904415823	r =1.1003338521204054=1.100333852120405
iter 8	e =0.4965034907660435	r =0.632187299372714=0.6321872993727117
iter 9	e =0.4876288321528935	r =0.04560081757292288=0.0456008175729222
iter 10	e =0.4852535525452267	r =0.01868198951544235=0.018681989515442445
iter 11	e =5.355895016044437e-11	r =2.6971698001819823e-9=2.697163286555595e-9
iter 12	e =3.001543200572167e-14	r =1.586992659053566e-13=1.5814319898642047e-13
iter 13	e =2.9052029490791163e-14	r =2.36614331702114e-14=2.676266972361379e-14
iter 14	e =2.8302601013784463e-14	r =2.233512325441824e-14=2.230002999102391e-14
iter 15	e =2.7769982441376475e-14	r =1.9367343898069464e-14=1.9657773761207833e-14
iter 16	e =2.770617551834015e-14	r =6.545209881380098e-15=1.1702524284689016e-14
iter 17	e =2.7698788596305558e-14	r =3.1255074356178937e-15=9.821751247852607e-15
iter 18	e =2.7574261857901847e-14	r =5.734257681444875e-15=1.009407791187898e-14

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Untitled1.i...	a minute ago

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Code Julia 1.9.3

Fitting models to data

```
[ ]:
```

Simple 0 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 1 Untitled1.ipynb

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MEASUREMENTS OF Ω AND Λ FROM 42 HIGH-REDSHIFT SUPERNOVAE

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Department of Astronomy, University of Barcelona, Barcelona, Spain.

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B. SCHAEFER

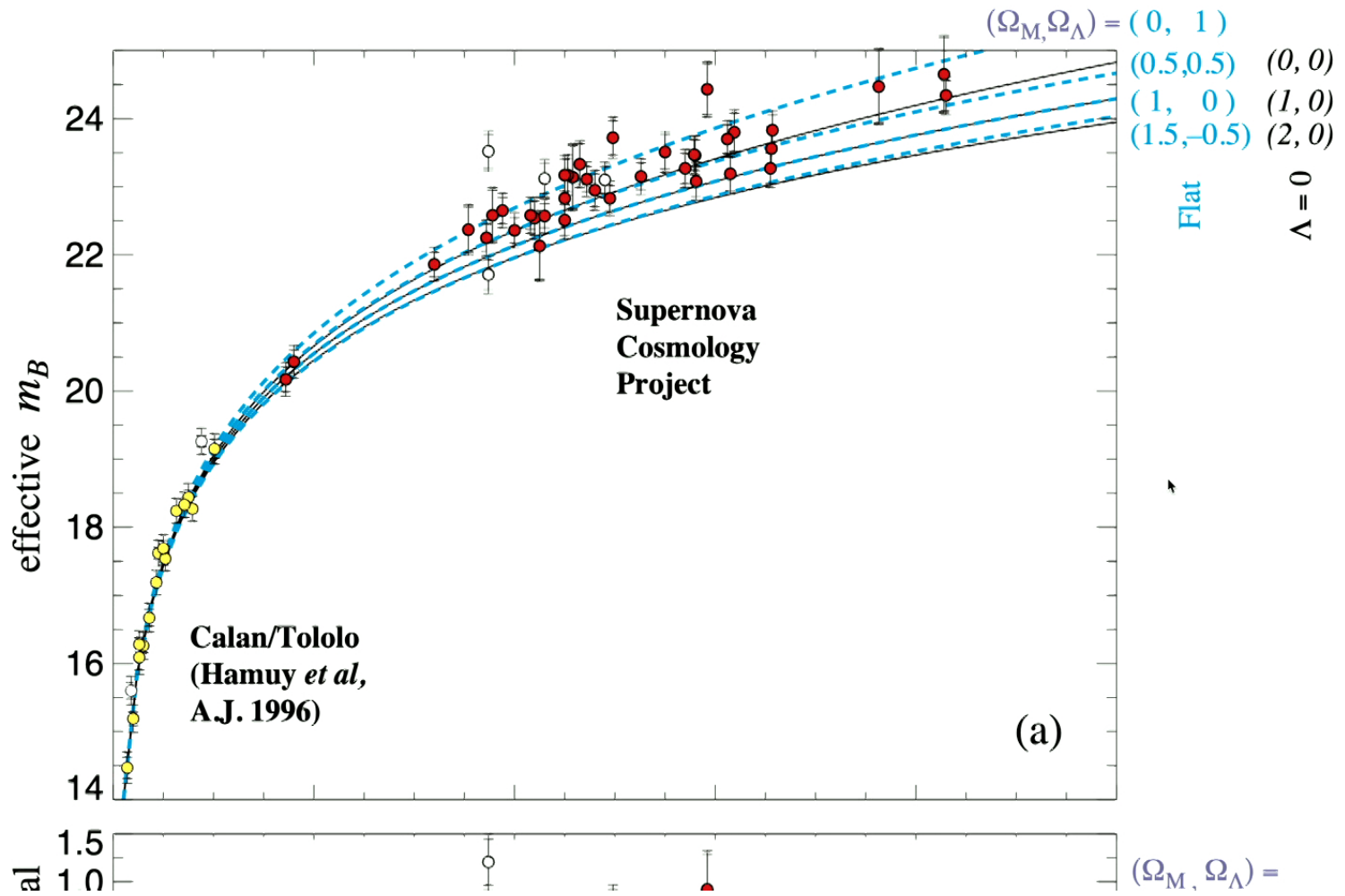
Department of Astronomy, Yale University, New Haven, Connecticut.

B. J. BOYLE

Anglo-Australian Observatory, Sydney, Australia.

A. V. FILIPPENKO, T. MATHESON

18 Dec 1998



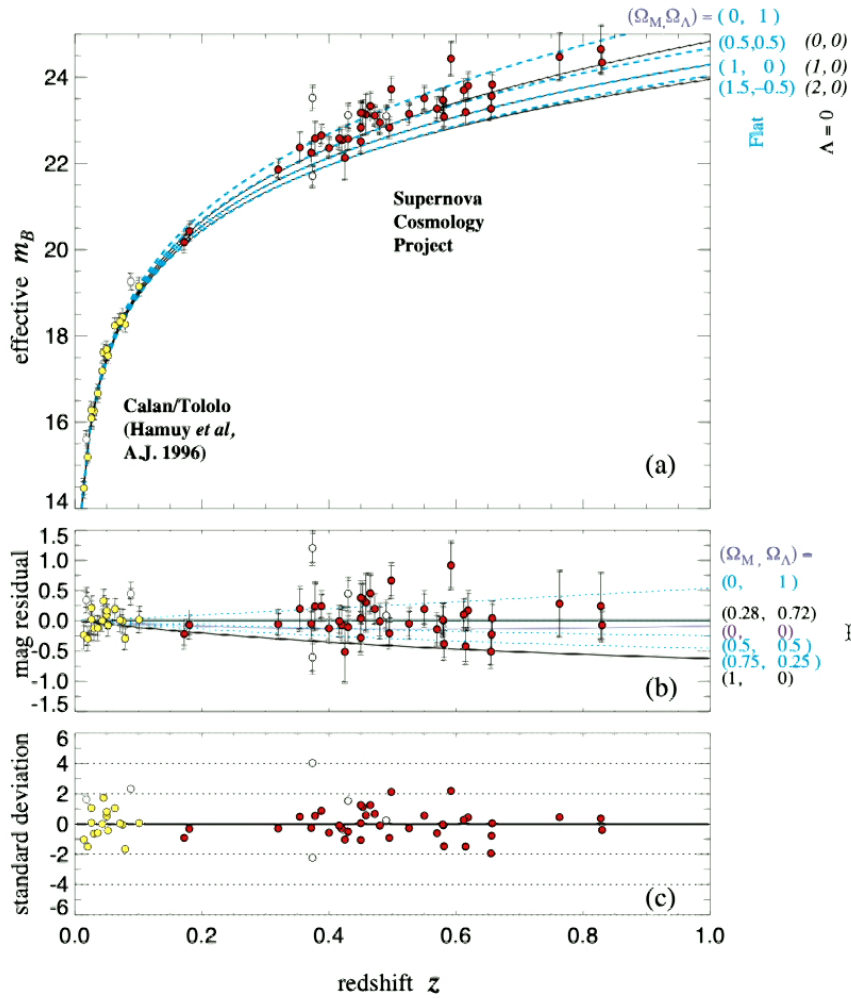


FIG. 2.—

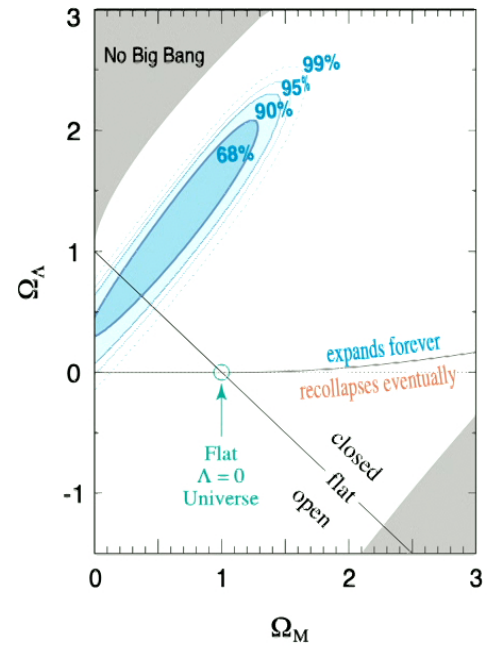


FIG. 7.— Best-fit confidence regions in the Ω_M - Ω_Λ plane for our primary analysis, Fit C. The 68%, 90%, 95%, and 99% statistical confidence regions in the Ω_M - Ω_Λ plane are shown, after integrating the four-dimensional fit over M_B and α . (The table of this two-dimensional probability distribution is available at <http://www.supernova.lbl.gov/>.) See Figure 5(c) for limits on the small shifts in these contours due to identified systematic uncertainties. Note that the spatial curvature of the universe—open, flat, or closed—is not determinative of the future of the universe’s expansion, indicated by the near-horizontal solid line. In cosmologies above this near-horizontal line the universe will expand forever, while below this line the expansion of the universe will eventually come to a halt and recollapse. This line is not quite horizontal because at very high mass density there is a region where the mass density can bring the expansion to a halt before the scale of the universe is big enough that the mass density is diluted with respect to the cosmological constant energy density. The upper-left shaded region, labeled “no big bang,” represents “bouncing universe” cosmologies with no big bang in the past (see Carroll, Press, & Turner 1992). The lower right shaded region corresponds to a universe that is younger than the oldest heavy elements (Schramm 1990), for any value of $H_0 \geq 50 \text{ km s}^{-1} \text{ Mpc}^{-1}$.

30

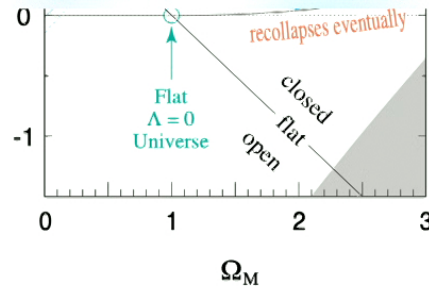
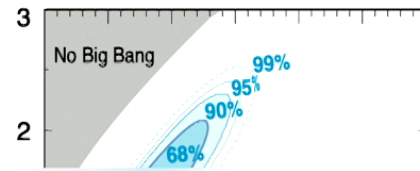


FIG. 7.— Best-fit confidence regions in the Ω_M - Ω_Λ plane for our primary analysis, Fit C. The 68%, 90%, 95%, and 99% statistical confidence regions in the Ω_M - Ω_Λ plane are shown, after integrating the four-dimensional fit over M_B and α . (The table of this two-dimensional probability distribution is available at <http://www.supernova.lbl.gov/>.) See Figure 5(c) for limits on the small shifts in these contours due to identified systematic uncertainties. Note that the spatial curvature of the universe—open, flat, or closed—is not determinative of the future of the universe’s expansion, indicated by the near-horizontal solid line. In cosmologies above this near-horizontal line the universe will expand forever, while below this line the expansion of the universe will eventually come to a halt and recollapse. This line is not quite horizontal because at very high mass density there is a region where the mass density can bring the expansion to a halt before the scale of the universe is big enough that the mass density is diluted with respect to the cosmological constant energy density. The upper-left shaded region, labeled “no big bang,” represents “bouncing universe” cosmologies with no big bang in the past (see Carroll, Press, & Turner 1992). The lower right shaded region corresponds to a universe that is younger than the oldest heavy elements (Schramm 1990), for any value of $H_0 \geq 50 \text{ km s}^{-1} \text{ Mpc}^{-1}$.

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Fitting models to data

```
[2]: ] add CSV

Warning: could not download https://pkg.julialang.org/registries
exception = RequestError: Couldn't connect to server while requesting https://pkg.julialang.org/registries
@ Pkg.Registry /cm/shared/apps/julia/julia-1.9.3/share/julia/stdlib/v1.9/Pkg/src/Registry/Registry.jl:69
Resolving package versions...
No Changes to `~/.julia/environments/v1.9/Project.toml`
No Changes to `~/.julia/environments/v1.9/Manifest.toml`

[3]: using Pkg
      Pkg.add("CSV")

Resolving package versions...
No Changes to `~/.julia/environments/v1.9/Project.toml`
No Changes to `~/.julia/environments/v1.9/Manifest.toml`

• [4]: ] add DataFrames
      ] add 0

Resolving package versions...
No Changes to `~/.julia/environments/v1.9/Project.toml`
No Changes to `~/.julia/environments/v1.9/Manifest.toml`

[ ]:
```

Simple 0 3 Julia 1.9.3 | Idle Mode: Edit Ln 2, Col 8 Untitled1.ipynb

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Code Julia 1.9.3

```
[2]: ] add CSV

Warning: could not download https://pkg.julialang.org/registries
exception = RequestError: Couldn't connect to server while requesting https://pkg.julialang.org/registries
@ Pkg.Registry /cm/shared/apps/julia/julia-1.9.3/share/julia/stdlib/v1.9/Pkg/src/Registry/Registry.jl:69
Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[3]: using Pkg
      Pkg.add("CSV")

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[6]: ] add DataFrames

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[7]: ] add Optim

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[ ]: ] add |
```

Simple 0 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 7 Untitled1.ipynb

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Code Julia 1.9.3

```
[2]: ] add CSV

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exception = RequestError: Couldn't connect to server while requesting https://pkg.julialang.org/registries
@ Pkg.Registry /cm/shared/apps/julia/julia-1.9.3/share/julia/stdlib/v1.9/Pkg/src/Registry/Registry.jl:69
Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[3]: using Pkg
      Pkg.add("CSV")

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[6]: ] add DataFrames

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[7]: ] add Optim

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[8]: ] add WGLMakie

Resolving package versions...
No Changes to `~/julia/environments/v1.9/Project.toml`
No Changes to `~/julia/environments/v1.9/Manifest.toml`

[ ]: |
```

Simple 0 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 1 Untitled1.ipynb

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Launcher

Python 3.8 (module) Python 3.9 (module)

Python 3.8 (module) Python 3.9 (module)

Console

Python 3 Julia 1.9.3 Mathematica 13.3 Python 3.10 (module) Python 3.11 (module) Python 3.6 (module) Python 3.7 (module)

Python 3.8 (module) Python 3.9 (module)

Other

Terminal Text File Markdown File Julia File Python File Show Contextual Help

Simple 0 3 Launcher

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Untitled.ip...	11 minutes ago
Untitled1.i...	a minute ago

```
Terminal 1
dlang@cn001:~$ cd FittingAModel2024/
dlang@cn001:~/FittingAModel2024$ cat data.csv
row,x,y,sigma_y,sigma_x,rho_xy
1,201,592,61,9,-0.84
2,244,401,25,4,0.31
3,47,583,38,11,0.64
4,287,402,15,7,-0.27
5,203,495,21,5,-0.33
6,58,173,15,9,0.67
7,210,479,27,4,-0.02
8,202,504,14,4,-0.05
9,198,510,30,11,-0.84
10,158,416,16,7,-0.69
11,165,393,14,5,0.30
12,201,442,25,5,-0.46
13,157,317,52,5,-0.03
14,131,311,16,6,0.50
15,166,400,34,6,0.73
16,160,337,31,5,-0.52
17,186,423,42,9,0.90
18,125,334,26,8,0.40
19,218,533,16,6,-0.78
20,146,344,22,5,-0.56
dlang@cn001:~/FittingAModel2024$
```

Simple 1 3 Terminal 1

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Untitled.ip...	12 minutes ago
Untitled1.i...	a minute ago

```
Terminal 1
dlang@cn001:~$ cd FittingAModel2024/
dlang@cn001:~/FittingAModel2024$ cat data.csv
row,x,y,sigma_y,sigma_x,rho_xy
1,201,592,61,9,-0.84
2,244,401,25,4,0.31
3,47,583,38,11,0.64
4,287,402,15,7,-0.27
5,203,495,21,5,-0.33
6,58,173,15,9,0.67
7,210,479,27,4,-0.02
8,202,504,14,4,-0.05
9,198,510,30,11,-0.84
10,158,416,16,7,-0.69
11,165,393,14,5,0.30
12,201,442,25,5,-0.46
13,157,317,52,5,-0.03
14,131,311,16,6,0.50
15,166,400,34,6,0.73
16,160,337,31,5,-0.52
17,186,423,42,9,0.90
18,125,334,26,8,0.40
19,218,533,16,6,-0.78
20,146,344,22,5,-0.56
dlang@cn001:~/FittingAModel2024$
```

Simple 1 3 Terminal 1

Firefox File Edit View History Bookmarks Tools Window Help 08:42 MST 53°C 0rpm 03:06:12:63 dstn Tue Jan 16 10:43 AM

home/dlang/Fitt (auto-w : 2) - J X

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	13 minutes ago
Untitled1.i...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb x Julia 1.9.3

No Changes to `~/julia/environments/v1.9/Manifest.toml`

```
[10]: using CSV
      using DataFrames
```

```
[11]: alldata = CSV.read("data.csv", DataFrame)
```

```
[11]: 20x6 DataFrame
```

Row	row	x	y	sigma_y	sigma_x	rho_xy
	Int64	Int64	Int64	Int64	Int64	Float64
1	1	201	592	61	9	-0.84
2	2	244	401	25	4	0.31
3	3	47	583	38	11	0.64
4	4	287	402	15	7	-0.27
5	5	203	495	21	5	-0.33
6	6	58	173	15	9	0.67
7	7	210	479	27	4	-0.02
8	8	202	504	14	4	-0.05
9	9	198	510	30	11	-0.84
10	10	158	416	16	7	-0.69

Simple 1 s_ 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 42 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:43 MST 55°C Orpm 03:06:13:31 Tue Jan 16 10:44 AM

home/dlang/Fitt (auto-w : 2) x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	13 minutes ago
Untitled1.i...	a minute ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

No Changes to `~/julia/environments/v1.9/Manifest.toml`

```
[10]: using CSV
      using DataFrames

[13]: alldata = CSV.read("data.csv", DataFrame);

[15]: alldata.sigma_y

[15]: 20-element Vector{Int64}:
      61
      25
      38
      15
      21
      15
      27
      14
      30
      16
      14
      25
      52
      16
      34
      31
      42
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 1 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:45 MST 53°C Orpm 03:06:14:56 dstn Tue Jan 16 10:45 AM

home/dlang/Fitt (auto-w : 2) x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	15 minutes ago
Untitled1.i...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

No Changes to `~/julia/environments/v1.9/Manifest.toml`

```
[10]: using CSV
      using DataFrames

[13]: alldata = CSV.read("data.csv", DataFrame);

[16]: data = alldata[5:end, :];

[ ]: f = Figure()
      Axis(f[1,1])
      errorbars!(data.x, data.y, data.sigma_y)|
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 3, Col 41 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:45 MST 53°C Orpm 03:06:14:59 dstn Tue Jan 16 10:45 AM

home/dlang/Fitt (auto-w : 2) - J X
https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	15 minutes ago
Untitled1.i...	seconds ago

```
[10]: using CSV
      using DataFrames

[13]: alldata = CSV.read("data.csv", DataFrame);

[16]: data = alldata[5:end, :];

[17]: f = Figure()
      Axis(f[1,1])
      errorbars!(data.x, data.y, data.sigma_y)
      f

      UndefVarError: `Figure` not defined

      Stacktrace:
      [1] top-level scope
           @ In[17]:1

[ ]: |
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 1 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:45 MST 53°C Orpm 03:06:16:11 Tue Jan 16 10:45 AM

home/dlang/Fitt (auto-w : 2) - J X
https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	15 minutes ago
Untitled1.i...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

No Changes to `~/julia/environments/v1.9/Manifest.toml`

```
[*]: using CSV
      using DataFrames
      using WGLMakie

[13]: alldata = CSV.read("data.csv", DataFrame);

[16]: data = alldata[5:end, :];

[17]: f = Figure()
      Axis(f[1,1])
      errorbars!(data.x, data.y, data.sigma_y)
      f

      UndefVarError: `Figure` not defined

      Stacktrace:
        [1] top-level scope
             @ In[17]:1

[ ]:
```

Simple 1 3 Julia 1.9.3 | Busy Mode: Command Ln 1, Col 43 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:45 MST 52°C Orpm 03:06:16:53 dstn Tue Jan 16 10:46 AM

home/dlang/Fitt (auto-w : 2) - J X
https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

File Edit View Run Kernel Tabs Settings Help

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	16 minutes ago
Untitled1.i...	a minute ago

```
[18]: using CSV
      using DataFrames
      using WGLMakie

[13]: alldata = CSV.read("data.csv", DataFrame);

[16]: data = alldata[5:end, :];

[*]: f = Figure()
      Axis(f[1,1])
      errorbars!(data.x, data.y, data.sigma_y)
      f

[Warning: Port in use, using different port. New port: 9385
@ Bonito.HTTPServer ~/.julia/packages/Bonito/ULACo/src/HTTPServer/implementation.jl:274

[ ]:
```

Simple 1 3 Julia 1.9.3 | Busy Mode: Command Ln 1, Col 1 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 08:48 MST 55°C Orpm 03:06:16:26 Tue Jan 16 10:46 AM

home/dlang/Fitt (auto-w: 2) - J X
https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 170% Search

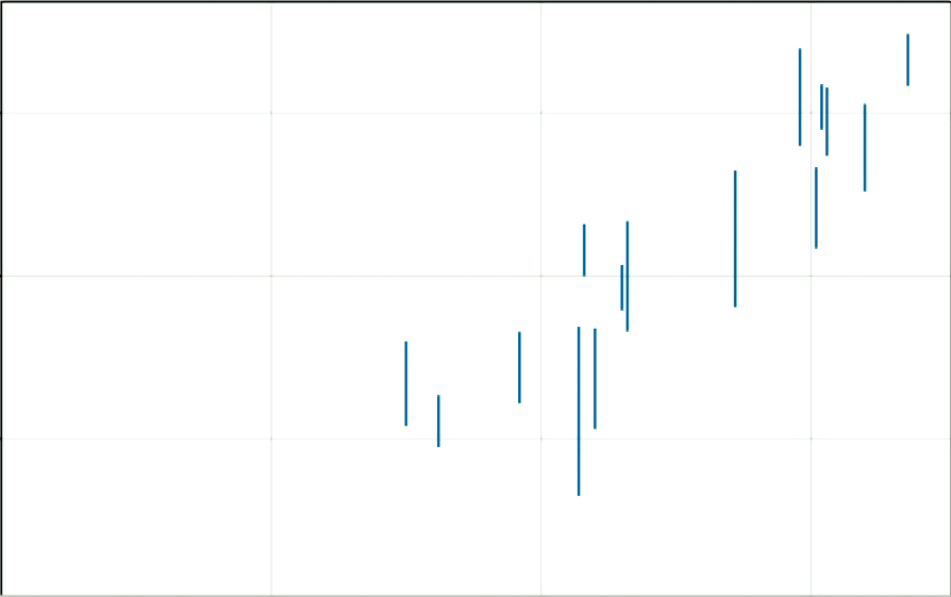
File Edit View Run Kernel Tabs Settings Help

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

```
[19]: f = Figure()  
Axis(f[1,1])  
errorbars!(data.x, data.y, data.sigma_y)  
f
```

[Warning: Port in use, using different port. New port: 9385
@ Bonito.HTTPServer ~/.julia/packages/Bonito/ULACo/src/HTTPServer/implementation.jl:274

```
[19]:
```



Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 1 Untitled1.ipynb

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	16 minutes ago
Untitled1.i...	2 minutes ago

Firefox File Edit View History Bookmarks Tools Window Help 08:47 MST 62°C Orpm 03:06:17:27 Tue Jan 16 10:47 AM

home/dlang/Fitt (auto-w : 2) - J x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	17 minutes ago
Untitled1.l...	a minute ago

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

```
[16]: data = alldata[5:end, :];

[*]: f = Figure()
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")
errorbars!(data.x, data.y, data.sigma_y)
scatter!(data.x, data.y, markersize=20, color=:red)
f

[ ]:
```

Simple 1 3 Julia 1.9.3 | Busy Mode: Command Ln 1, Col 1 Untitled1.ipynb

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	17 minutes ago
Untitled1.l...	a minute ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

```
[16]: data = alldata[5:end, :];
```

```
[21]: f = Figure()  
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")  
errorbars!(data.x, data.y, data.sigma_y)  
scatter!(data.x, data.y, markersize=20, color=:red)  
f
```

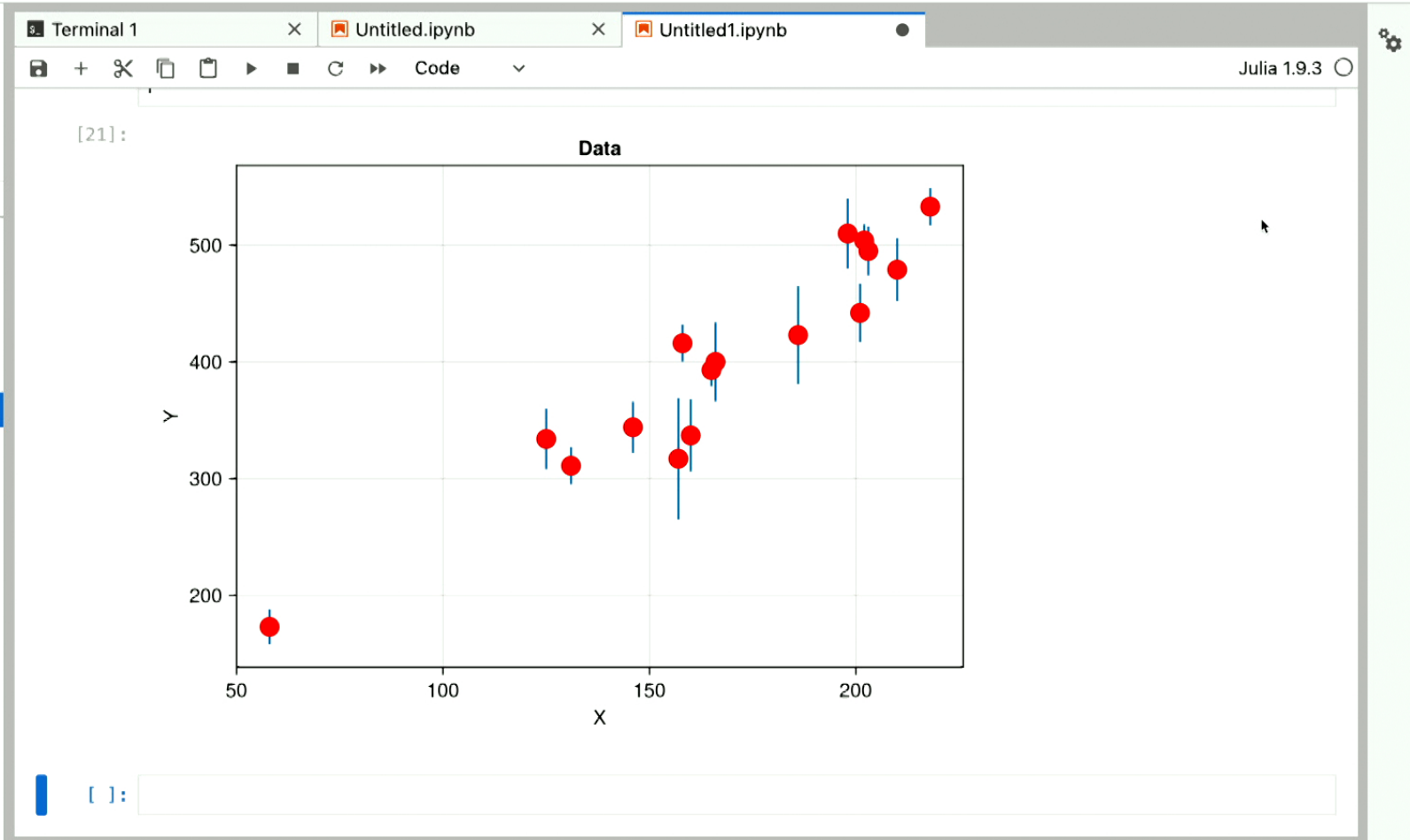
[21]:

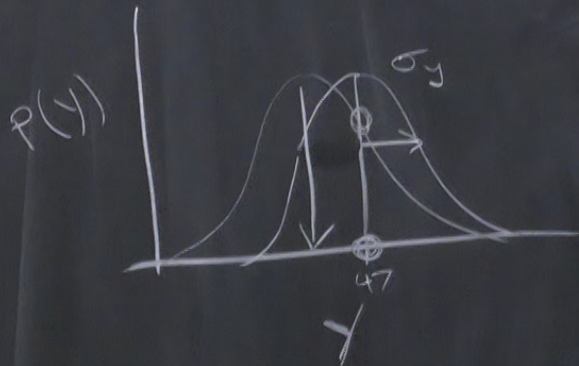
X	Y	Y Error (sigma_y)
0	180	10
1	340	20
2	310	15
3	350	20
4	320	25
5	340	20
6	420	20
7	400	25
8	430	20
9	510	25
10	500	20
11	490	25
12	530	20

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	18 minutes ago
Untitled1.l...	a minute ago





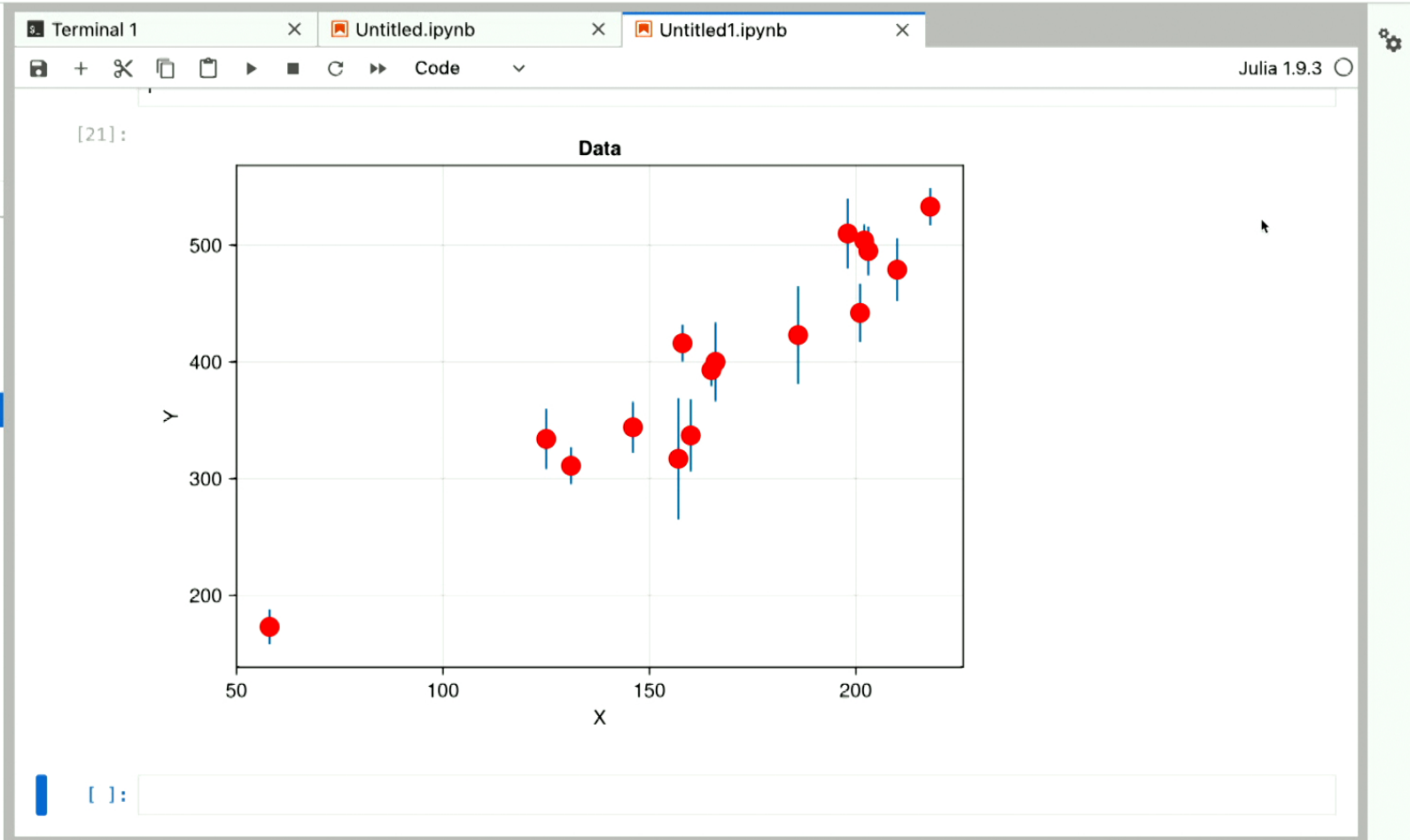
Likelihood

$$P(y_{\text{meas}} | y_{\text{true}}) = N(\mu = y_{\text{true}}, \sigma = \sigma_y)$$
$$= \frac{1}{\sqrt{2\pi}\sigma_y} \exp\left(-\frac{1}{2} \frac{(y_{\text{meas}} - y_{\text{true}})^2}{\sigma_y^2}\right)$$

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	27 minutes ago
Untitled1.l...	8 minutes ago



Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	29 minutes ago
Untitled1.l...	10 minutes ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code v Julia 1.9.3

```
[ ]:  
[ ]:  
[ ]:
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 1 Untitled1.ipynb

Filter files by name 🔍

/ ... / dlang
/ FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	30 minutes ago
Untitled1.l...	11 minutes ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

```
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")  
errorbars!(data.x, data.y, data.sigma_y)  
scatter!(data.x, data.y, markersize=20, color=:red)  
f
```

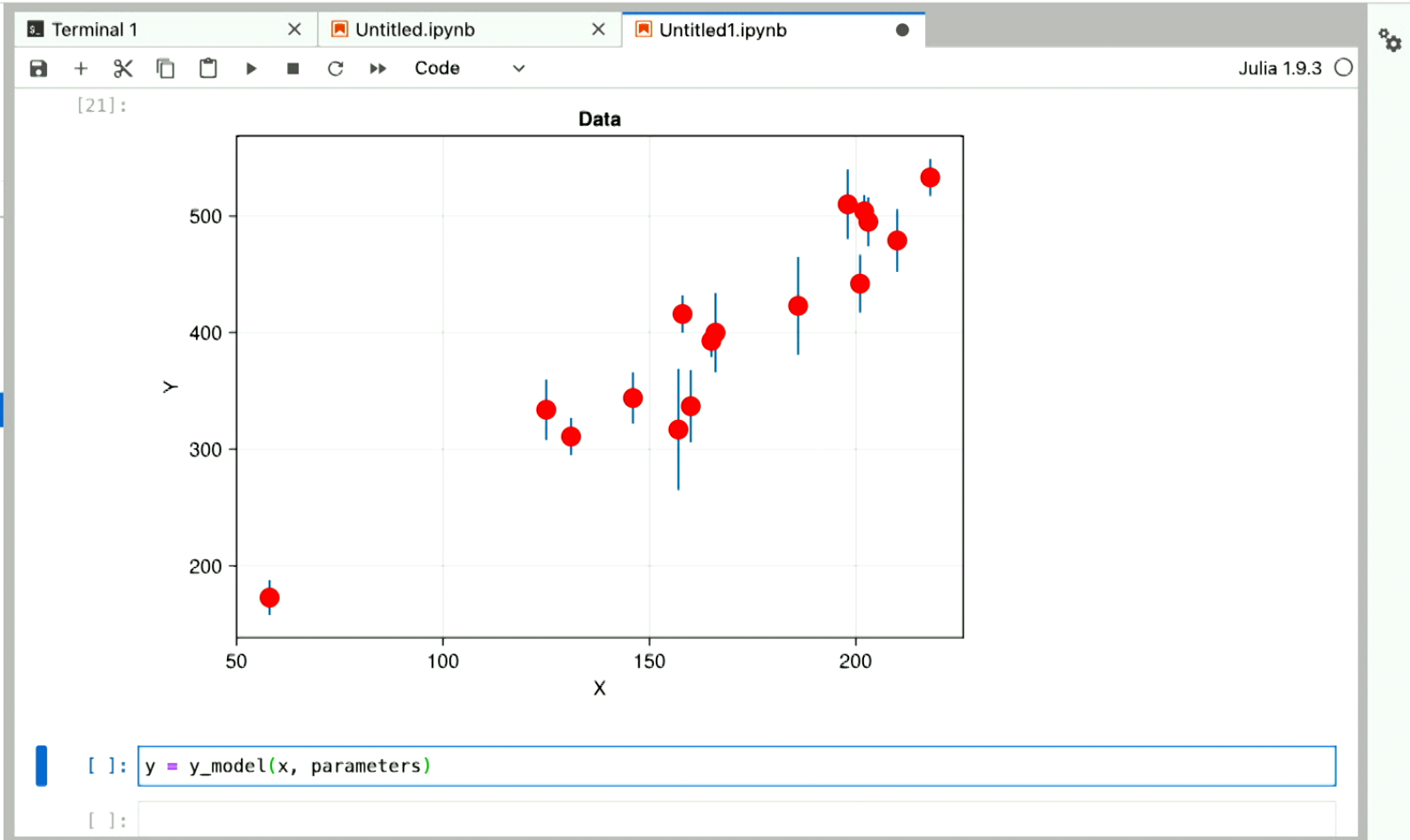
[21]:

X	Y
60	180
130	340
140	310
150	350
160	320
160	340
165	420
170	400
190	430
200	510
205	450
220	540

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	30 minutes ago
Untitled1.l...	12 minutes ago



Firefox File Edit View History Bookmarks Tools Window Help 09:01 MST 59°C 1248rpm 03:06:31:46 Tue Jan 16 11:02 AM

home/dlang/Fitt (auto-w: 2) - J x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	32 minutes ago
Untitled1.l...	a minute ago

```
[ ]: # y_pred = y_model(x, parameters)
# likelihood =

[ ]:

[ ]:

[23]: function my_func(x)
return sin.(x) ./ x
end;
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 2, Col 16 Untitled1.ipynb

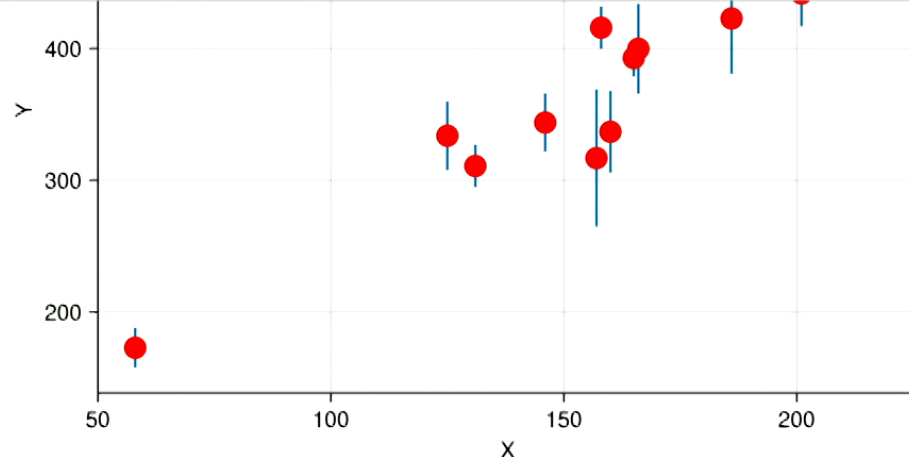
Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	32 minutes ago
Untitled1.l...	2 minutes ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code v Julia 1.9.3



```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[23]: function my_func(x)
return sin.(x) ./ x
end;
```

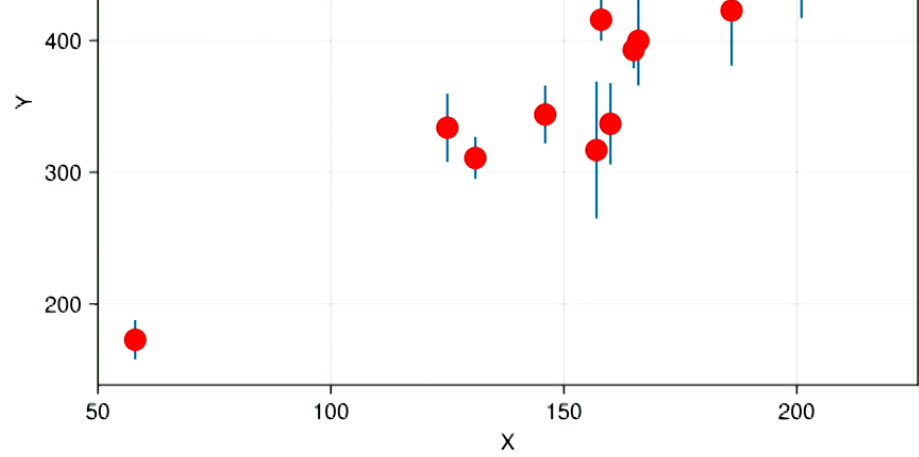
Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	33 minutes ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb x

Code v Julia 1.9.3



```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[23]: function my_func(x)
return sin.(x) ./ x
end;
```

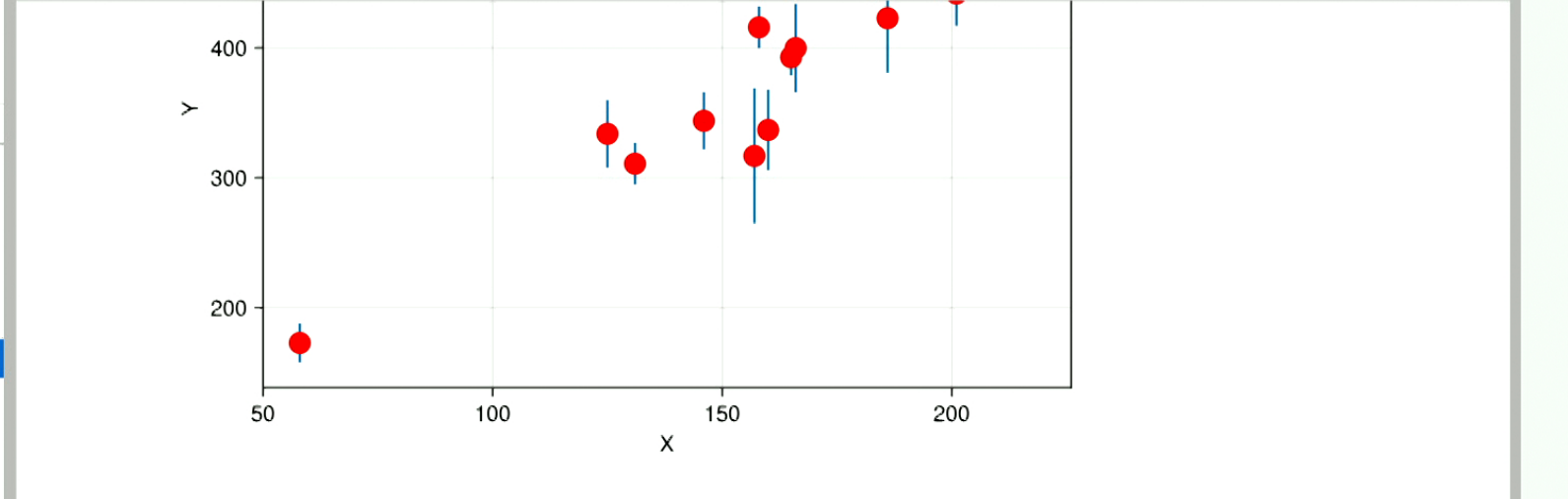
Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	34 minutes ago
Untitled1.l...	2 minutes ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb x

Code v Julia 1.9.3



```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[23]: function my_func(x)
return sin.(x) ./ x
end;
```

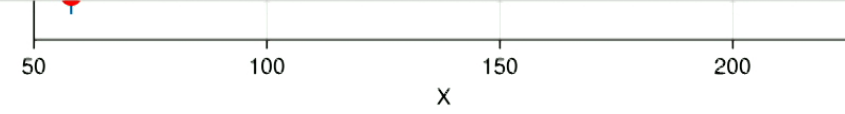
Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	35 minutes ago
Untitled1.l...	3 minutes ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code v Julia 1.9.3



```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[24]: function my_func(x)
return sin.(x) ./ x
end;

[25]: x_grid = LinRange(-5, +5, 100)

[25]: 100-element LinRange{Float64, Int64}:
-5.0, -4.89899, -4.79798, -4.69697, ..., 4.69697, 4.79798, 4.89899, 5.0

[ ]:
```


Firefox File Edit View History Bookmarks Tools Window Help 09:05 MST 59°C 1258rpm 03:06:35-34 Tue Jan 16 11:06 AM

home/dlang/Fitt (auto-w: 2) - J X

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	35 minutes ago
Untitled1.l...	3 minutes ago

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

Code

50 100 150 200 X

```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[24]: function my_func(x)
return sin.(x) ./ x
end;

• [25]: x_grid = LinRange(-5, +5, 100);

[25]: 100-element LinRange{Float64, Int64}:
-5.0, -4.89899, -4.79798, -4.69697, ..., 4.69697, 4.79798, 4.89899, 5.0

[ ]:
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 32 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:08 MST 58°C 1247rpm 03:06:36:16 dstn Tue Jan 16 11:06 AM

home/dlang/Fitt (auto-w: 2) - J x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	36 minutes ago
Untitled1.l...	3 minutes ago

Terminal 1 Untitled.ipynb Untitled1.ipynb Julia 1.9.3

```
[ ]: # y_pred = y_model(x, parameters)
# likelihood = gaussian_probability(y, y_pred, sigma_y)
# prod(likelihood)

[ ]:

[ ]:

[24]: function my_func(x)
return sin.(x) ./ x
end;

[26]: x_grid = LinRange(-5, +5, 100);

[*]: f = Figure()
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")
lines!(x_grid, my_func(x_grid))
f

[ ]: |
```

Simple 1 3 Julia 1.9.3 | Busy Mode: Edit Ln 1, Col 1 Untitled1.ipynb

09:06 MST 62°C 12:34pm 03:06:36:42 dsn Tue Jan 16 11:07 AM Firefox File Edit View History Bookmarks Tools Window Help home/dlang/Fitt (auto-w-2) - JupyterLab

File Edit View Run Kernel Tabs Settings Help

Untitled1.ipynb

```

f = Figure()
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")
lines!(x_grid, my_func(x_grid))
f

```

Data

X	Y
0	0.0
1	0.5
2	0.0
3	-0.5
4	-1.0

Terminal 1

```

[27]: f = Figure()
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")
lines!(x_grid, my_func(x_grid))
f

```

Filter files by name

/.../dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	37 minutes ago
Untitled1.i...	seconds ago

completed: 1 | Julia 1.9.3 | Mode: Edit | Ln 1, Col 1 | Untitled1.ipynb | Simple | 1 | Julia 1.9.3 | Idle | r 1 (c 1) | Untitled1 | Saving

The image shows a JupyterLab interface with three panels. Each panel displays a file browser on the left, a terminal with code in the middle, and a plot on the right.

Panel 1 (Left):

- File browser: Shows files like 'data.csv', 'fitting-1.ipynb', 'LICENSE', 'README.md', and 'Untitled.ipynb'.
- Terminal: Shows the code: `[29]: f = Figure(); Axis(f[1,1], title='Data', xlabel='X', ylabel='Y'); lines!(x_grid, my_func(x_grid)); f`.
- Plot: Shows a blue curve on a grid with x-axis labeled 'X' and y-axis labeled 'Y'.

Panel 2 (Middle):

- File browser: Shows files like 'data.csv', 'fitting-1.ipynb', 'LICENSE', 'README.md', and 'Untitled.ipynb'.
- Terminal: Shows the code: `[29]: f = Figure(); Axis(f[1,1], title='Data', xlabel='X', ylabel='Y'); lines!(x_grid, my_func(x_grid)); f`.
- Plot: Shows a blue curve on a grid with x-axis labeled 'X' and y-axis labeled 'Y'.

Panel 3 (Right):

- File browser: Shows files like 'data.csv', 'fitting-1.ipynb', 'LICENSE', 'README.md', and 'Untitled.ipynb'.
- Terminal: Shows the code: `[29]: f = Figure(); Axis(f[1,1], title='Data', xlabel='X', ylabel='Y'); lines!(x_grid, my_func(x_grid)); f`.
- Plot: Shows a blue curve on a grid with x-axis labeled 'X' and y-axis labeled 'Y'.

Firefox File Edit View History Bookmarks Tools Window Help 09:08 MST 62°C 1246rpm 03:06:37:59 Tue Jan 16 11:08 AM

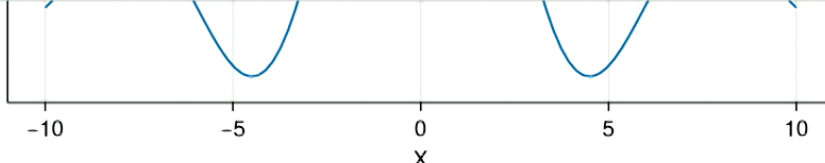
home/dlang/Fitt (auto-w : 2) x +

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code v Julia 1.9.3



Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	38 minutes ago
Untitled1.l...	a minute ago

```
[30]: using Optim

[31]: optimize(my_func, [5.])
```

MethodError: Cannot `convert` an object of type `Vector{Float64}` to an object of type `Float64`

Closest candidates are:

- `convert(::Type{T}, ::ColorTypes.Gray24)` where `T<:Real`
@ `ColorTypes` ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:114
- `convert(::Type{T}, ::ColorTypes.Gray)` where `T<:Real`
@ `ColorTypes` ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:113
- `convert(::Type{T}, ::Base.TwicePrecision)` where `T<:Number`
@ `Base` `twiceprecision.jl`:273
- ...

Stacktrace:

- `setproperty!(x::NonDifferentiable{Float64, Vector{Float64}}, f::Symbol, v::Vector{Float64})`
@ `Base` `./Base.jl`:38
- `value!(obj::NonDifferentiable{Float64, Vector{Float64}}, x::Vector{Float64})`
@ `NLSolversBase` ~/.julia/packages/NLSolversBase/kavn7/src/interface.jl:9
- `initial_state(method::NelderMead{Optim.AffineSimplexer, Optim.AdaptiveParameters}, options::Optim.Opti`
@ `Optim` `./src/initial_state.jl`:57

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 24 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:09 MST 61°C 1250rpm 03:06:39:05 Tue Jan 16 11:09 AM

home/dlang/Fitt (auto-w: 2) - J x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	39 minutes ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code v Julia 1.9.3

```
[30]: using Optim

[32]: function my_func(x)
      return sin.(x) ./ x
      end;

[*]: my_func([5.])

[31]: optimize(my_func, [5.])

MethodError: Cannot `convert` an object of type Vector{Float64} to an object of type Float64

Closest candidates are:
  convert(::Type{T}, ::ColorTypes.Gray24) where T<:Real
    @ ColorTypes ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:114
  convert(::Type{T}, ::ColorTypes.Gray) where T<:Real
    @ ColorTypes ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:113
  convert(::Type{T}, ::Base.TwicePrecision) where T<:Number
    @ Base twiceprecision.jl:273
  ...

Stacktrace:
 [1] setproperty!(x::NonDifferentiable{Float64, Vector{Float64}}, f::Symbol, v::Vector{Float64})
    @ Base ./Base.jl:38
 [2] value!!(obj::NonDifferentiable{Float64, Vector{Float64}}, x::Vector{Float64})
    @ NLSolversBase ~/.julia/packages/NLSolversBase/kavn7/src/interface.jl:9
 [3] initial_state(method::NelderMead{Optim.AffineSimplex, Optim.AdaptiveParameters}, options::Optim.Opti
```

Simple 1 3 Julia 1.9.3 | Busy Mode: Command Ln 1, Col 24 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:10 MST 59°C 1252rpm 03:06:40:07 Tue Jan 16 11:10 AM

home/dlang/Fitt (auto-w: 2) - J x +
 https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	40 minutes ago
Untitled1.l...	a minute ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

```
[30]: using Optim
[32]: function my_func(x)
      return sin.(x) ./ x
      end;
[33]: my_func([5.])
[33]: 1-element Vector{Float64}:
      -0.1917848549326277

[ ]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end
[31]: optimize(my_func, [5.])

MethodError: Cannot `convert` an object of type Vector{Float64} to an object of type Float64

Closest candidates are:
  convert(::Type{T}, ::ColorTypes.Gray24) where T<:Real
    @ ColorTypes ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:114
  convert(::Type{T}, ::ColorTypes.Gray) where T<:Real
    @ ColorTypes ~/.julia/packages/ColorTypes/1dGw6/src/conversions.jl:113
  convert(::Type{T}, ::Base.TwicePrecision) where T<:Number
    @ Base twiceprecision.jl:273
  ...
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 3, Col 11 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:11 MST 62°C 1245rpm 03:06:40:59 dstn Tue Jan 16 11:11 AM

home/dlang/Fitt (auto-w: 2) x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	41 minutes ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

Code Julia 1.9.3

```
[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

[37]: opt = optimize(my_func_adapter, [5.])

[37]: * Status: success
      * Candidate solution
        Final objective value: -2.172336e-01
      * Found with
        Algorithm: Nelder-Mead
      * Convergence measures
         $\sqrt{(\sum(y_i - \bar{y})^2)/n} \leq 1.0e-08$ 
      * Work counters
        Seconds run: 0 (vs limit Inf)
        Iterations: 9
        f(x) calls: 21

[ ]:
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 1 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:11 MST 59°C 1238rpm 03:06:41:13 dstn Tue Jan 16 11:11 AM

home/dlang/Fitt (auto-w : 2) - J x +

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	41 minutes ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

```
[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

[37]: opt = optimize(my_func_adapter, [5.])

[37]: * Status: success
      * Candidate solution
        Final objective value: -2.172336e-01
      * Found with
        Algorithm: Nelder-Mead
      * Convergence measures
         $\sqrt{\sum(y_i - \bar{y})^2} / n \leq 1.0e-08$ 
      * Work counters
        Seconds run: 0 (vs limit Inf)
        Iterations: 9
        f(x) calls: 21

[38]: Optim.minimizer(opt)

[38]: 1-element Vector{Float64}:
      4.493428039550782

[ ]:
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 1 Untitled1.ipynb

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	42 minutes ago
Untitled1.l...	a minute ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb

```
Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")  
lines!(x_grid, my_func(x_grid))  
scatter!(x_opt, my_func(x_opt))  
f
```

[40]:

Y

X

Firefox File Edit View History Bookmarks Tools Window Help 09:12 MST 60°C 1262rpm 03:06:42:54 dstn Tue Jan 16 11:13 AM

home/dlang/Fitt (auto-w: 2) x +
https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	43 minutes ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

```
[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

• [37]: opt = optimize(my_func_adapter, [-1.])

[37]: * Status: success
      * Candidate solution
        Final objective value: -2.172336e-01
      * Found with
        Algorithm: Nelder-Mead
      * Convergence measures
         $\sqrt{(\sum(y_i - \bar{y})^2)/n} \leq 1.0e-08$ 
      * Work counters
        Seconds run: 0 (vs limit Inf)
        Iterations: 9
        f(x) calls: 21

[39]: x_opt = Optim.minimizer(opt)

[39]: 1-element Vector{Float64}:
      4.493428039550782

[40]: f = Figure()
      Axis(f[1,1], title="Data", xlabel="X", ylabel="Y")
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 36 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:13 MST 59°C 1246rpm 03:06:43:52 dstn Tue Jan 16 11:14 AM

home/dlang/Fitt (auto-w: 2) - J x +

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	44 minutes ago
Untitled1.l...	a minute ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

```
[32]: function my_func(x)
      return sin.(x) ./ x
      end;

[33]: my_func([5.])

[33]: 1-element Vector{Float64}:
      -0.1917848549326277

[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

[ ]:

[41]: opt = optimize(my_func_adapter, [-1.])

[41]: * Status: success

      * Candidate solution
        Final objective value: -2.172336e-01

      * Found with
        Algorithm: Nelder-Mead

      * Convergence measures
         $\sqrt{(\sum(y_i - \hat{y})^2)/n} \leq 1.0e-08$ 
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 1 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:14 MST 59°C 1249rpm 03:06:44:49 dstn Tue Jan 16 11:15 AM

home/dlang/Fitt (auto-w : 2) x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	an hour ago
Untitled1.l...	seconds ago

```
Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3
```

```
[33]: my_func([5.])
```

```
[33]: 1-element Vector{Float64}:
      -0.1917848549326277
```

```
[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;
```

```
[44]: opt = optimize(xi -> sum(my_func(xi)), [-1.])
```

```
[44]: * Status: success
      * Candidate solution
        Final objective value: -2.172336e-01
      * Found with
        Algorithm: Nelder-Mead
      * Convergence measures
         $\sqrt{(\sum(y_i - \bar{y})^2)/n} \leq 1.0e-08$ 
      * Work counters
        Seconds run: 0 (vs limit Inf)
        Iterations: 10
        f(x) calls: 23
```

```
[41]: opt = optimize(my_func_adapter, [-1.])
```

```
[41]: * Status: success
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Command Ln 1, Col 39 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:15 MST 60°C 1256rpm 03:06:46:16 dstn Tue Jan 16 11:15 AM

home/dlang/Fitt (auto-w: 2) x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	an hour ago
Untitled1.l...	seconds ago

```

[33]: my_func([5.])

[33]: 1-element Vector{Float64}:
      -0.1917848549326277

[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

• [44]: #opt = optimize(xi -> sum(my_func(xi)), [-1.])

[44]: * Status: success

      * Candidate solution
        Final objective value:    -2.172336e-01

      * Found with
        Algorithm:    Nelder-Mead

      * Convergence measures
         $\sqrt{(\sum(y_i - \bar{y})^2)/n} \leq 1.0e-08$ 

      * Work counters
        Seconds run:    0 (vs limit Inf)
        Iterations:    10
        f(x) calls:    23

[41]: opt = optimize(my_func_adapter, [-1.])

[41]: * Status: success

```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 47 Untitled1.ipynb

Firefox File Edit View History Bookmarks Tools Window Help 09:15 MST 59°C 1232rpm 03:06:46:20 dstn Tue Jan 16 11:15 AM

home/dlang/Fitt (auto-w : 2) - J x

https://symmetry.pi.local/user/dlang/lab/workspaces/auto-w/tree/home/dlang/FittingAModel2024/Untitled1.ipynb 150% Search

File Edit View Run Kernel Tabs Settings Help

Filter files by name

/ ... / dlang / FittingAModel2024 /

Name	Last Modified
data.csv	a day ago
fitting-1.ip...	a day ago
LICENSE	a day ago
README.md	a day ago
Untitled.ip...	an hour ago
Untitled1.l...	seconds ago

Terminal 1 x Untitled.ipynb x Untitled1.ipynb Julia 1.9.3

```
[33]: my_func([5.])
[33]: 1-element Vector{Float64}:
      -0.1917848549326277

[35]: function my_func_adapter(x)
      v = my_func(x)
      sum(v)
      end;

• [44]: opt = optimize(xi -> sum(my_func(xi)), [-1.])
[44]: * Status: success
      * Candidate solution
        Final objective value: -2.172336e-01
      * Found with
        Algorithm: Nelder-Mead
      * Convergence measures
         $\sqrt{(\sum(y_i - \bar{y})^2)/n} \leq 1.0e-08$ 
      * Work counters
        Seconds run: 0 (vs limit Inf)
        Iterations: 10
        f(x) calls: 23

[41]: opt = optimize(my_func_adapter, [-1.])
[41]: * Status: success
```

Simple 1 3 Julia 1.9.3 | Idle Mode: Edit Ln 1, Col 1 Untitled1.ipynb