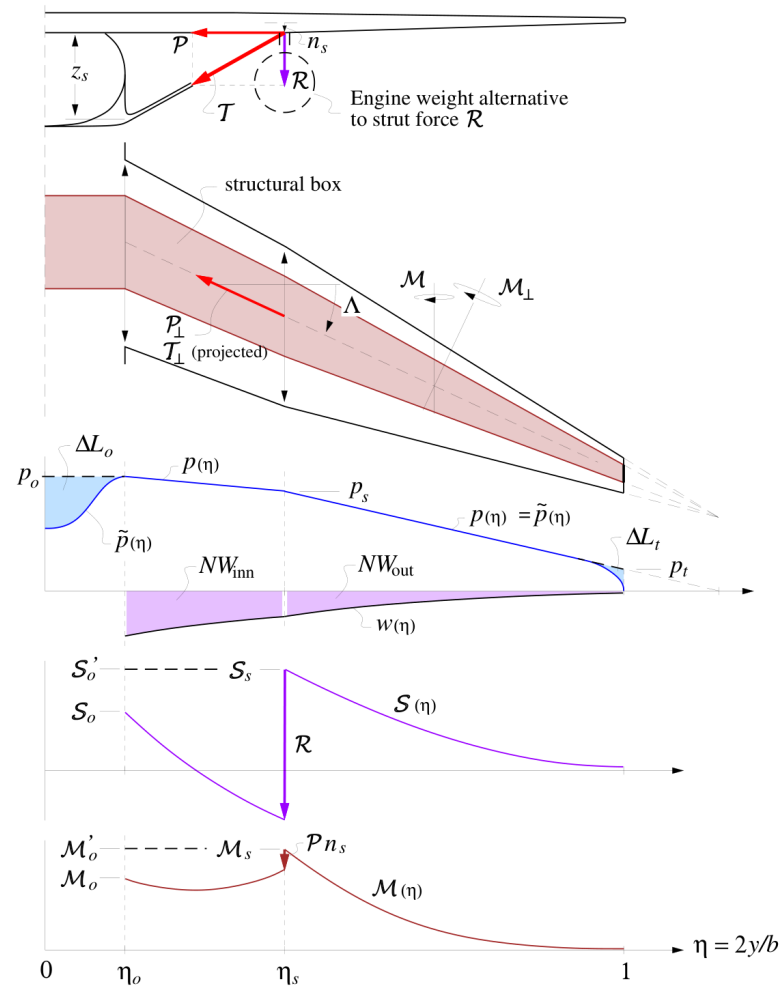
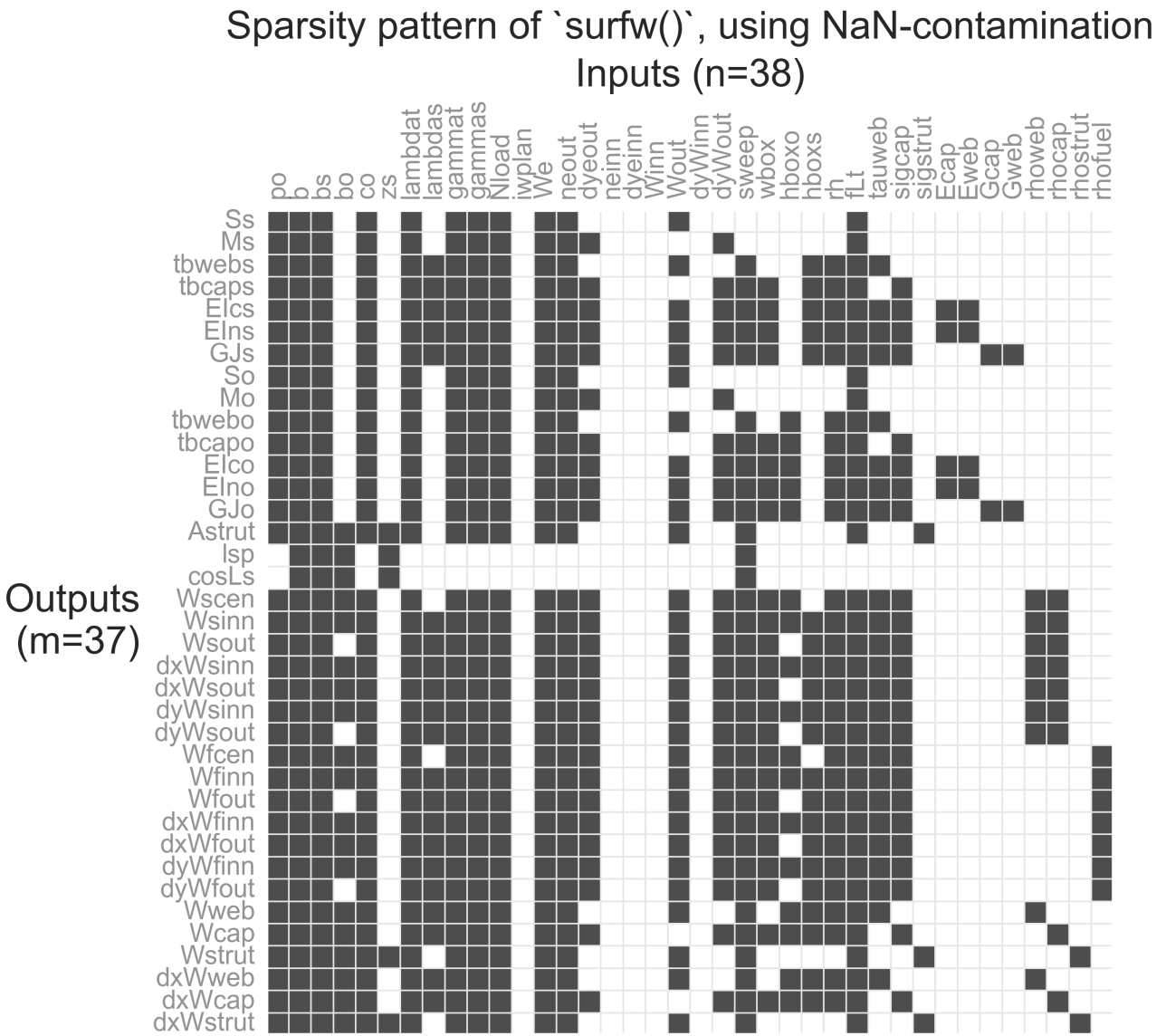
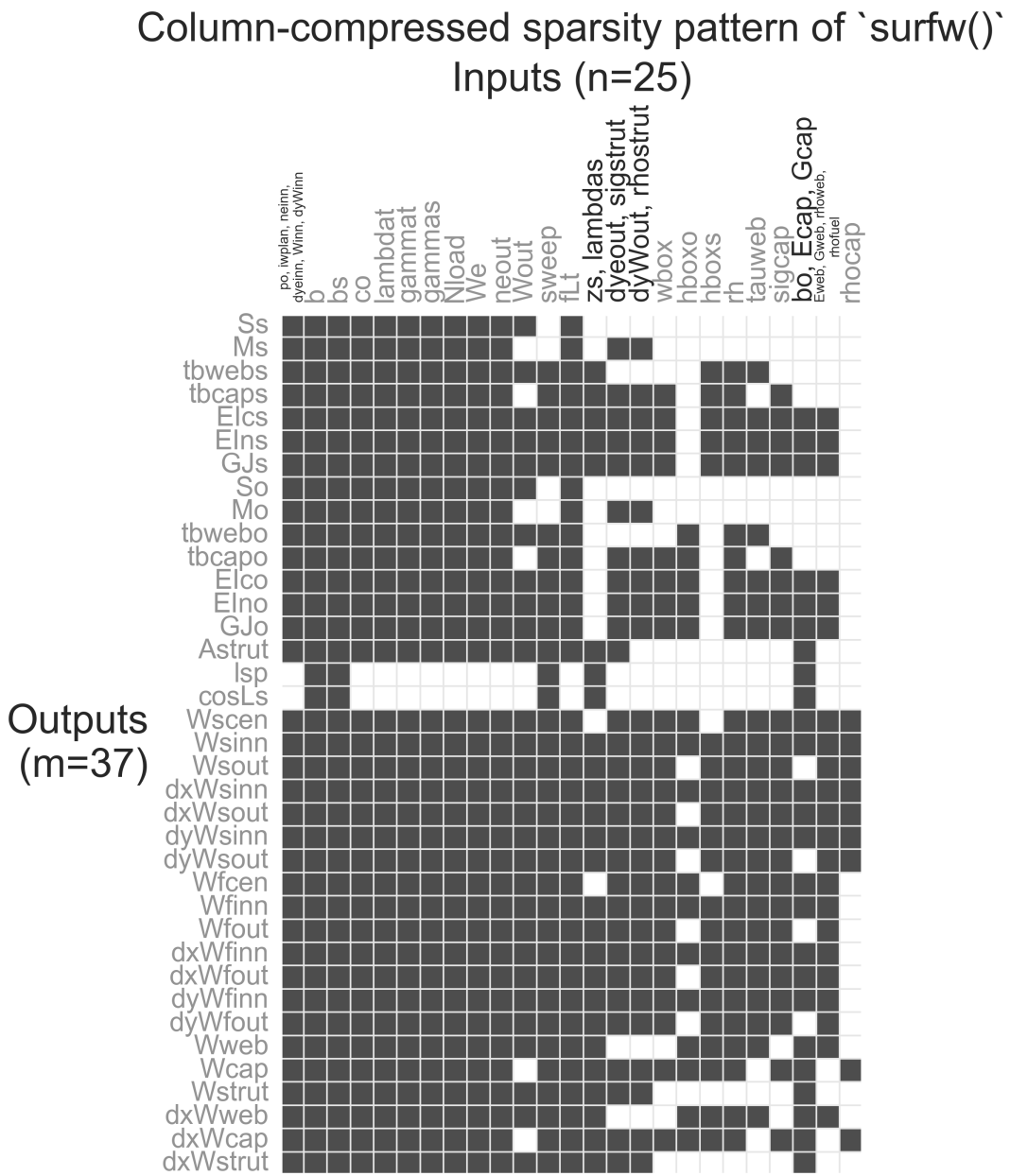

$\mathcal{P}$
n_s
z_s
$\mathcal{R}$
$\mathcal{T}$
Engine weight alternative
to strut force $\mathcal{R}$
structural box
$\mathcal{M}$
$\mathcal{M}_\perp$
Λ
$\mathcal{P}_\perp$
$\mathcal{T}_\perp$ (projected)
ΔL_o
p_o
$p(\eta)$
p_s
$p(\eta) = \tilde{p}(\eta)$
$\tilde{p}(\eta)$
ΔL_t
p_t
NW_{inn}
NW_{out}
$w(\eta)$
$\mathcal{S}_o'$
$\mathcal{S}_s$
$\mathcal{S}_o$
$\mathcal{S}(\eta)$
$\mathcal{R}$
$\mathcal{M}_o'$
$\mathcal{M}_s$
$\mathcal{P}n_s$
$\mathcal{M}_o$
$\mathcal{M}(\eta)$
$\eta = 2y/b$
0
η_o
η_s
1

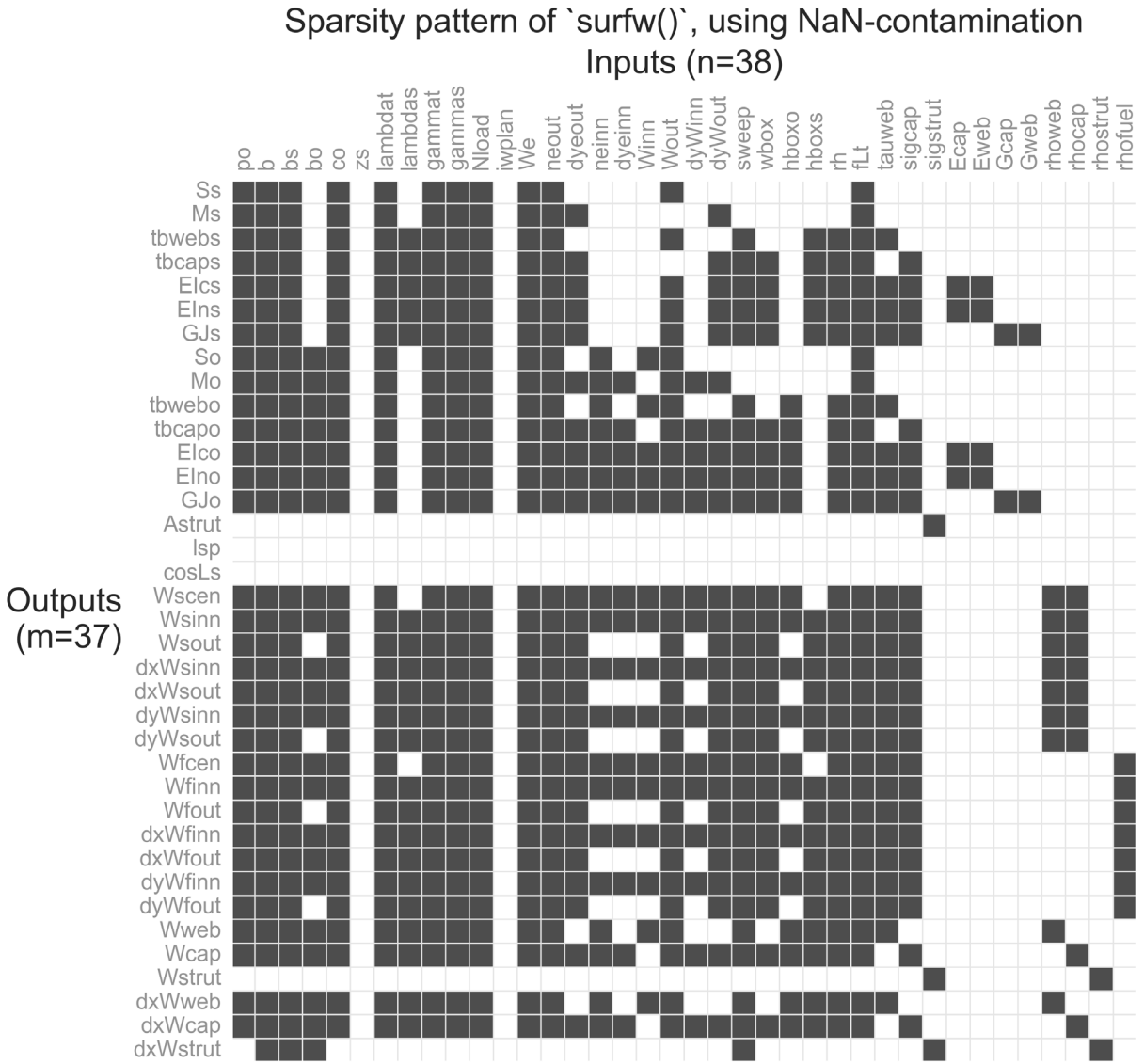
```
input_vector = [114115.099, 37.533, 10.697, ..., 2700.0, 817.0]
```

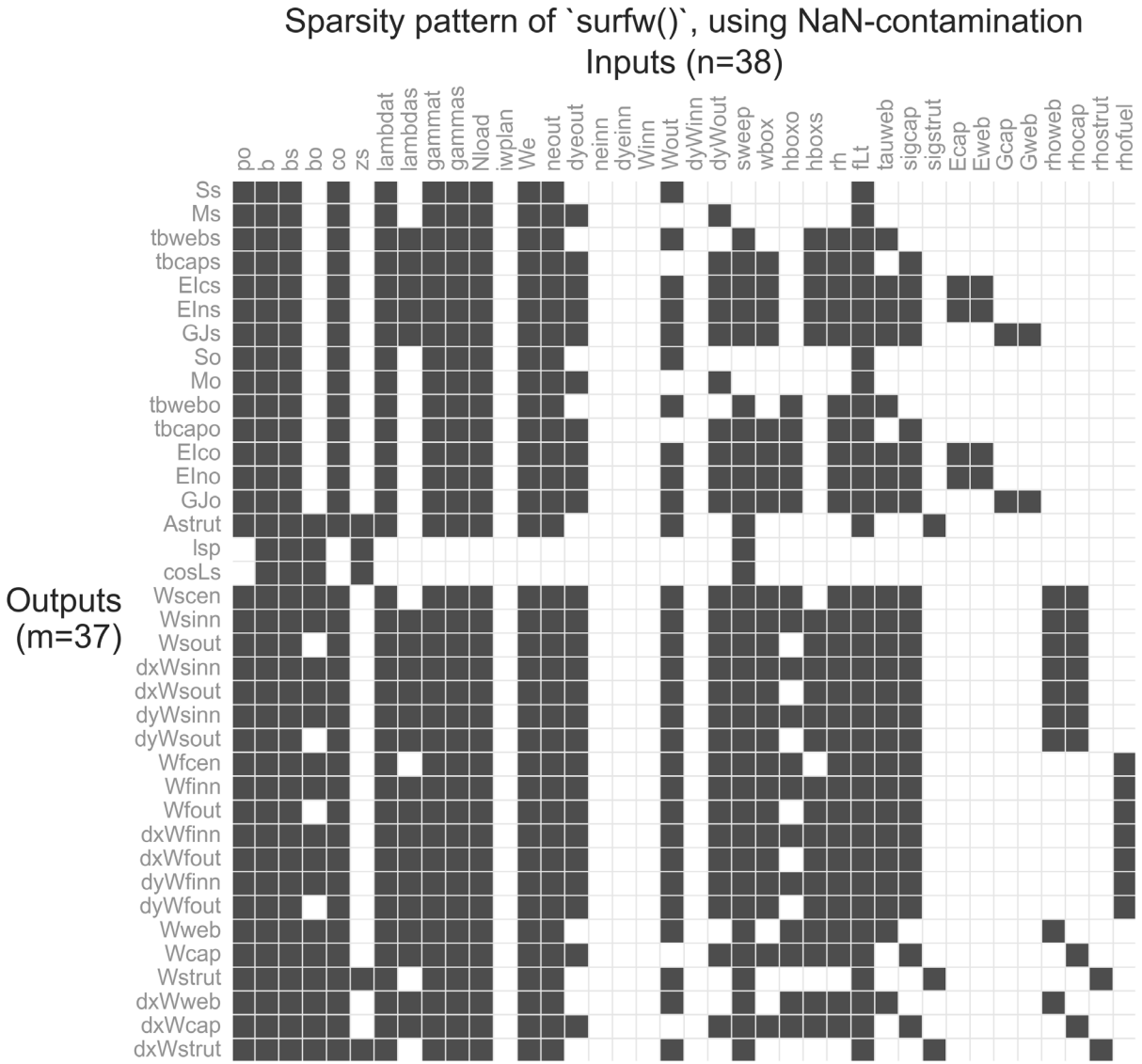
```
contaminated_input_vectors = [
                [       NaN, 37.533, 10.697, ..., 2700.0, 817.0],
                [114115.099,    NaN, 10.697, ..., 2700.0, 817.0],
                [114115.099, 37.533,    NaN, ..., 2700.0, 817.0],
                ...,
                [114115.099, 37.533, 10.697, ...,    NaN, 817.0],
                [114115.099, 37.533, 10.697, ..., 2700.0,   NaN],
]
```

```
contaminated_outputs[18] = [NaN, 3475012.2, NaN, ..., 170545.5, NaN]
```


Sparsity pattern of `surfw()`, using NaN-contamination
Inputs (n=38)
Outputs (m=37)
po
p
bs
bo
co
zs
lambdat
lambdas
gammat
gammas
Nload
iwplan
We
neout
dyeout
neinn
dyeinn
Winn
Wout
dyWinn
dyWout
sweep
wbox
hboxo
hboxs
rh
fLt
tauweb
sigcap
sigstrut
Ecap
Eweb
Gcap
Gweb
rhoweb
rhocap
rhostrut
rhofuel
Ss
Ms
tbwebs
tbcaps
Elcs
Elns
GJs
So
Mo
tbwebo
tbcapo
Elco
Elno
GJo
Astrut
lsp
cosLs
Wscen
Wsinn
Wsout
dxWsinn
dxWsout
dyWsinn
dyWsout
Wfcen
Wfinn
Wfout
dxWfinn
dxWfout
dyWfinn
dyWfout
Wweb
Wcap
Wstrut
dxWweb
dxWcap
dxWstrut


Column-compressed sparsity pattern of `surfw()`
Inputs (n=25)
po, iwplan, neinn, dyeinn, Winn, dyWinn
b
bs
co
lambdat
gammat
gammas
Nload
We
neout
Wout
sweep
fLt
zs, lambdas
dyeout, sigstrut
dyWout, rhostrut
wbox
hboxo
hboxs
rh
tauweb
sigcap
bo, Ecap, Gcap
Eweb, Gweb, rfloweb, rhofuel
rhocap
Outputs (m=37)
Ss
Ms
tbwebs
tbcaps
Elcs
Elns
GJs
So
Mo
tbwebo
tbcapo
Elco
Elno
GJo
Astrut
lsp
cosLs
Wscen
Wsinn
Wsout
dxWsinn
dxWsout
dyWsinn
dyWsout
Wfcen
Wfinn
Wfout
dxWfinn
dxWfout
dyWfinn
dyWfout
Wweb
Wcap
Wstrut
dxWweb
dxWcap
dxWstrut


Sparsity pattern of `surfw()`, using NaN-contamination
Inputs (n=38)
po
b
bs
bo
co
zs
lambdat
lambdas
gammat
gammas
Nload
iwplan
We
neout
dyeout
neinn
dyeinn
Winn
Wout
dyWinn
dyWout
sweep
wbox
hboxo
hboxs
rh
fLt
tauweb
sigcap
sigstrut
Ecap
Eweb
Gcap
Gweb
rhoweb
rhocap
rhostrut
rhofuel
Outputs
(m=37)
Ss
Ms
tbwebs
tbcaps
Elcs
Elns
GJs
So
Mo
tbwebo
tbcapo
Elco
Elno
GJo
Astrut
Isp
cosLs
Wscen
Wsinn
Wsout
dxWsinn
dxWsout
dyWsinn
dyWsout
Wfcen
Wfinn
Wfout
dxWfinn
dxWfout
dyWfinn
dyWfout
Wweb
Wcap
Wstrut
dxWweb
dxWcap
dxWstrut


Sparsity pattern of `surfw()`, using NaN-contamination
Inputs (n=38)
po
b
bs
bo
co
zs
lambdat
lambdas
gammat
gammas
Nload
iwplan
We
neout
dyeout
neinn
dyeinn
Winn
Wout
dyWinn
dyWout
sweep
wbox
hboxo
hboxs
rh
fLt
tauweb
sigcap
sigstrut
Ecap
Eweb
Gcap
Gweb
rhoweb
rhocap
rhostrut
rhofuel
Outputs
(m=37)
Ss
Ms
tbwebs
tbcaps
Elcs
Elns
GJs
So
Mo
tbwebo
tbcapo
Elco
Elno
GJo
Astrut
lsp
cosLs
Wscen
Wsinn
Wsout
dxWsinn
dxWsout
dyWsinn
dyWsout
Wfcen
Wfinn
Wfout
dxWfinn
dxWfout
dyWfinn
dyWfout
Wweb
Wcap
Wstrut
dxWweb
dxWcap
dxWstrut

Step 1:

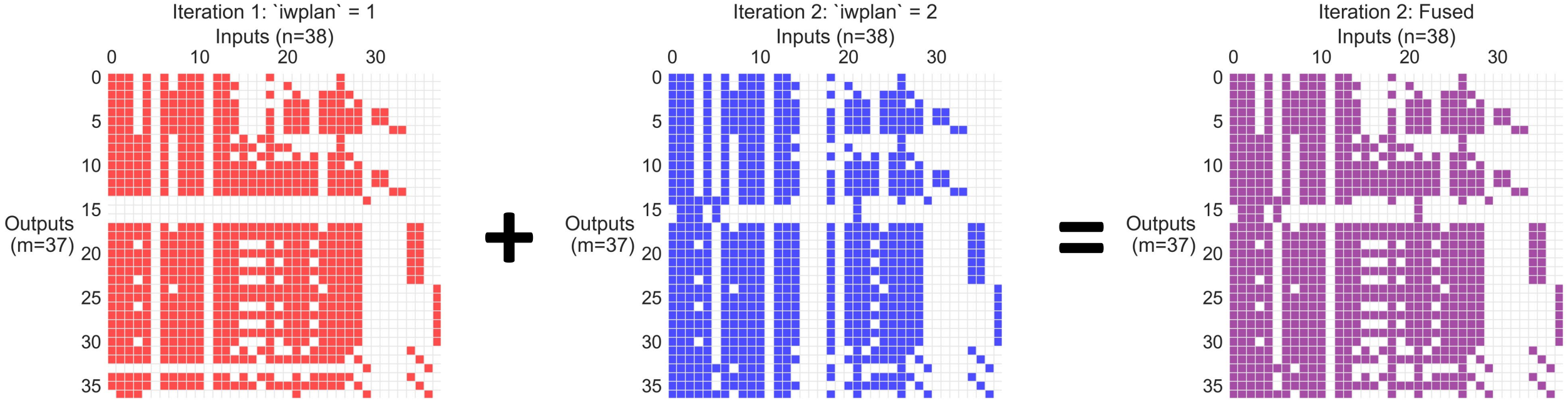
- Trace sparsity with NaN-propagation
- Compute gradient, take optimization step, etc.

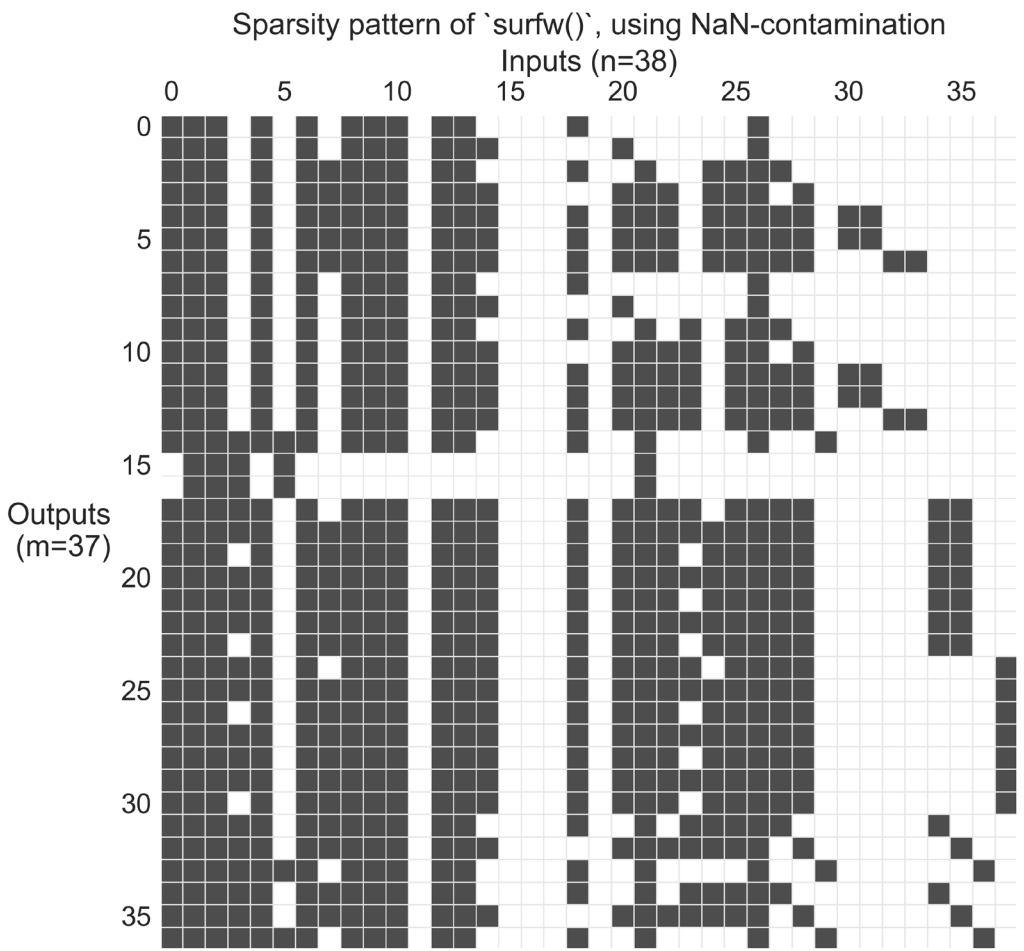
Step 2:

- At next iteration, if any new values for discrete variables are seen, redo the sparsity trace

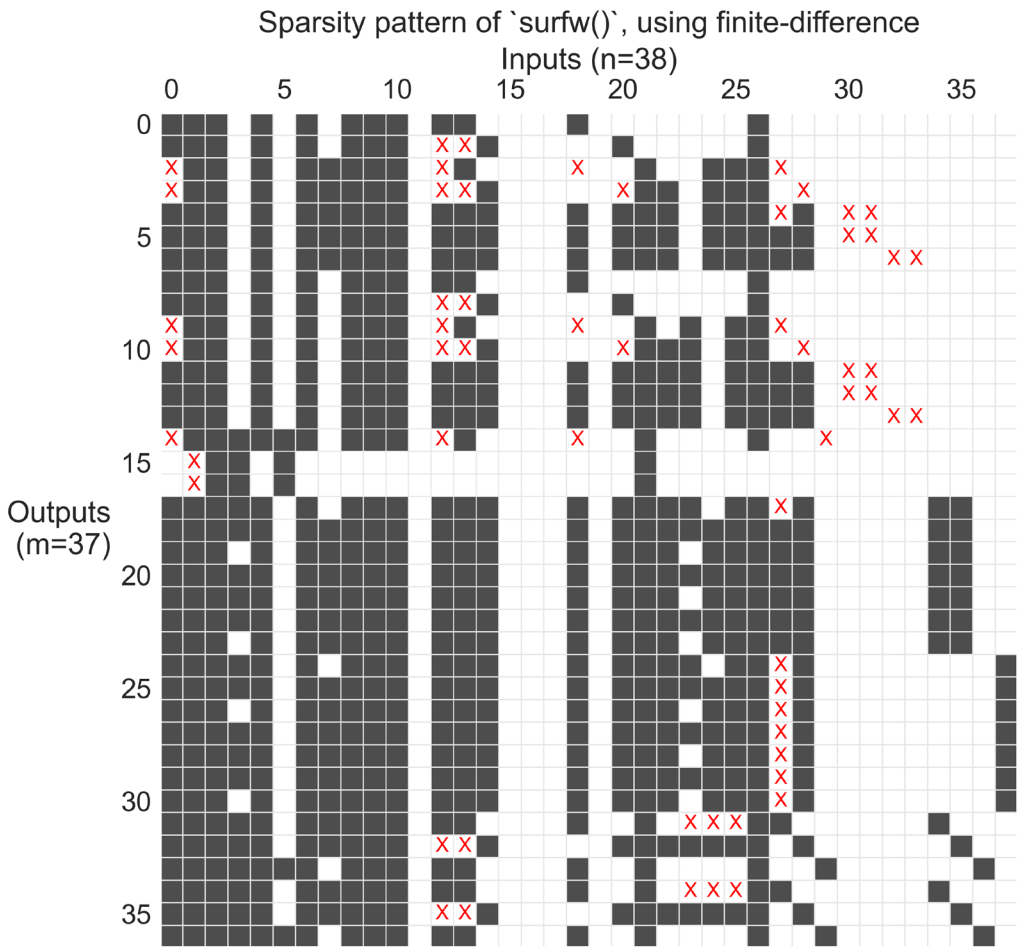
Step 3:

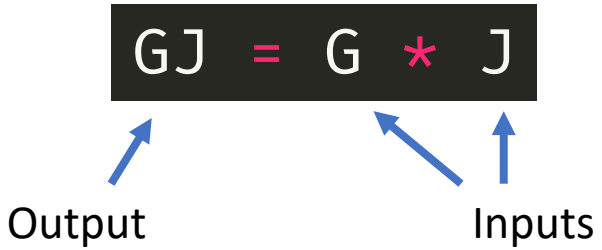
- Take the union of the new sparsity and the previous one, and use that going forward




Sparsity pattern of `surfw()`, using NaN-contamination
Inputs (n=38)
0
5
10
15
20
25
30
35
Outputs
(m=37)
0
5
10
15
20
25
30
35

X = false negatives!




GJ = G * J
Output
Inputs