Computational Microelectronics
L8

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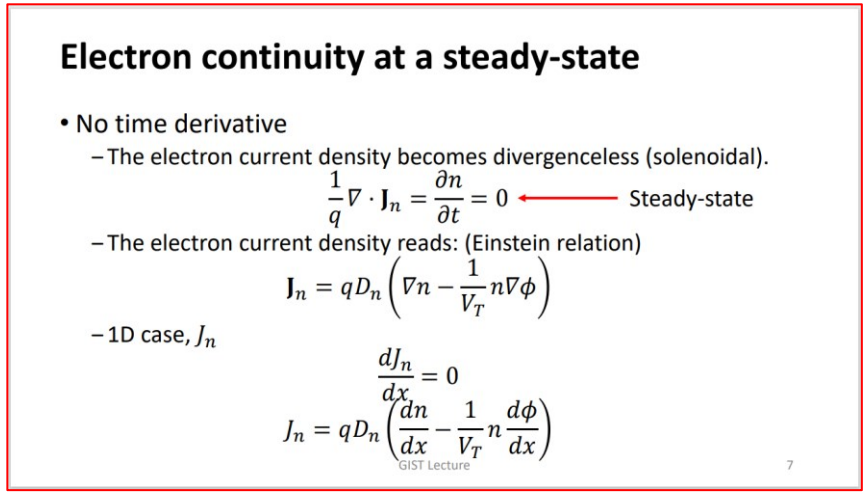
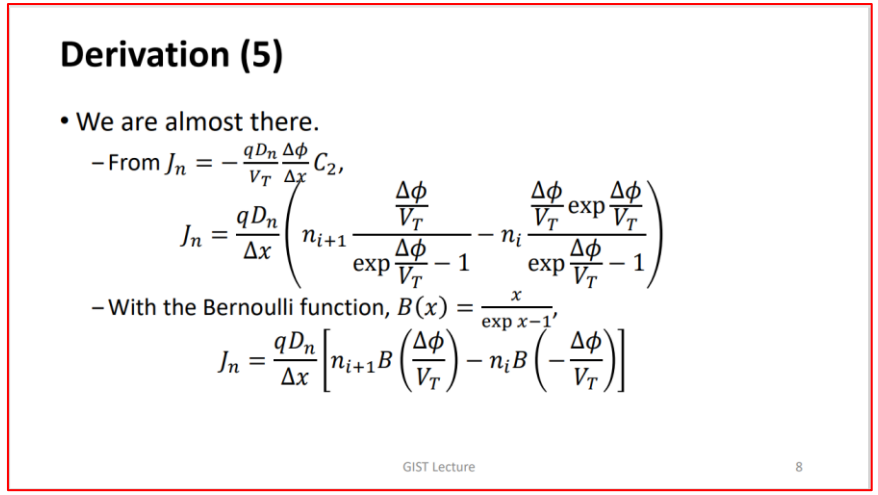
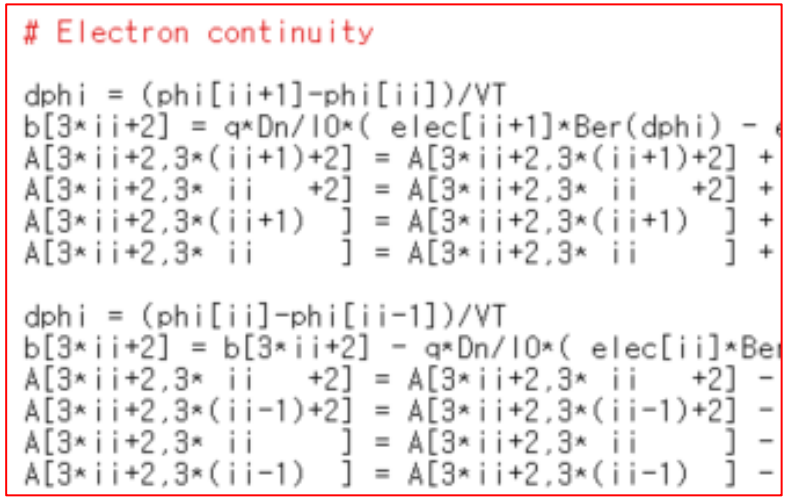
Neural network

Why neural networks in this course?

- Basically, this course is for the TCAD development.
  - Numerical analysis of a set of governing equations
  - Governing equations ➔ discretization ➔ implementation







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# Electron continuity

dphi = (phi[ii+1]-phi[ii])/VT
b[3*ii+2] = q*Dn/IO*( elec[ii+1]*Ber(dphi) - e
A[3*ii+2,3*(ii+1)+2] = A[3*ii+2,3*(ii+1)+2] +
A[3*ii+2,3* ii   +2] = A[3*ii+2,3* ii   +2] +
A[3*ii+2,3*(ii+1)  ] = A[3*ii+2,3*(ii+1)  ] +
A[3*ii+2,3* ii     ] = A[3*ii+2,3* ii     ] +

dphi = (phi[ii]-phi[ii-1])/VT
b[3*ii+2] = b[3*ii+2] - q*Dn/IO*( elec[ii]*Ber
A[3*ii+2,3* ii   +2] = A[3*ii+2,3* ii   +2] -
A[3*ii+2,3*(ii-1)+2] = A[3*ii+2,3*(ii-1)+2] -
A[3*ii+2,3* ii     ] = A[3*ii+2,3* ii     ] -
A[3*ii+2,3*(ii-1)  ] = A[3*ii+2,3*(ii-1)  ] -
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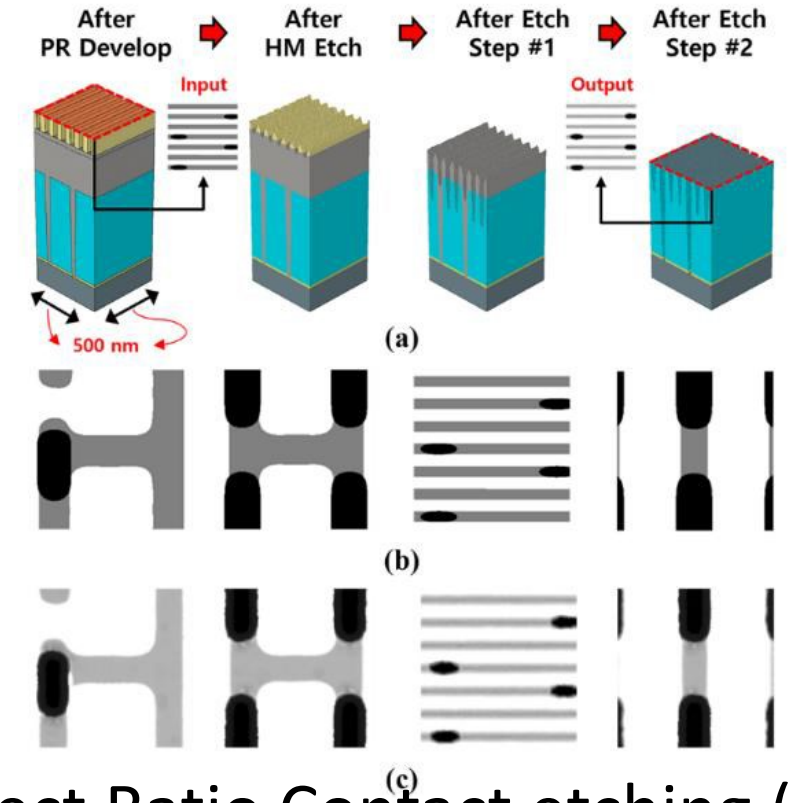
- It (“neural network”) is a new topic introduced this semester.
  - Data-driven approach

Recent applications (1)

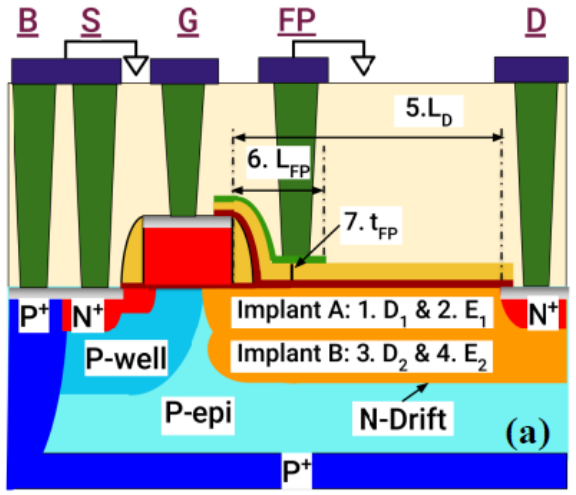
- Process
  - Early detection of process faults

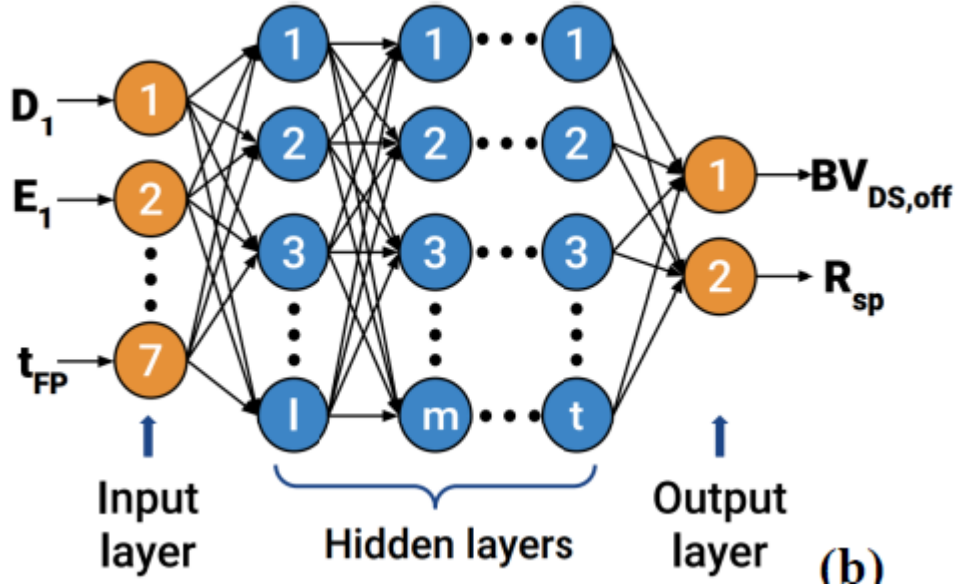


High Aspect Ratio Contact etching (SK hynix)

Recent applications (2)

- Surrogate model
  - A simple model to predict important parameters

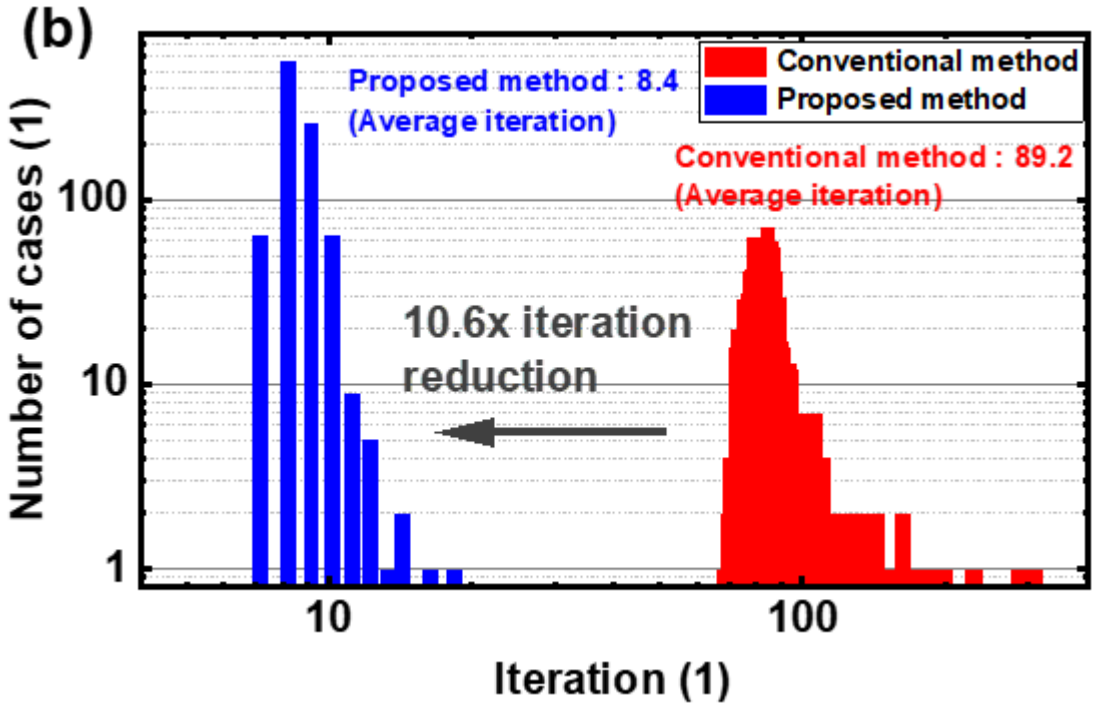




Surrogate model (IIT)

Recent applications (3)

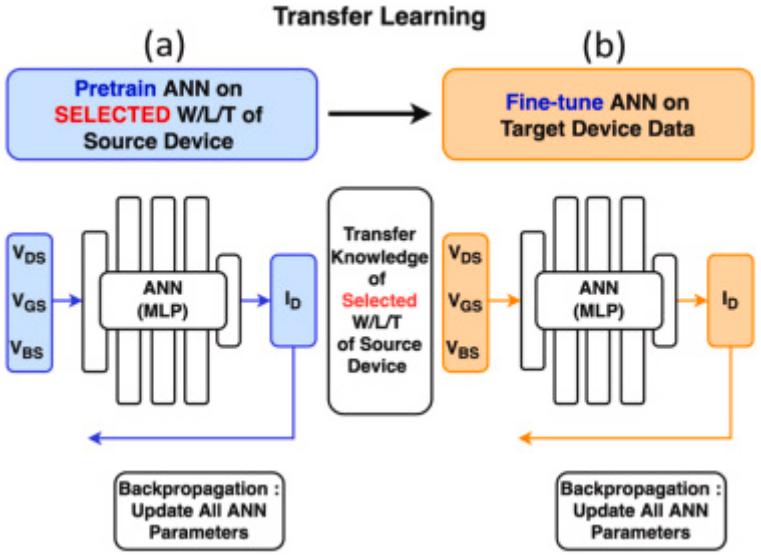
- TCAD acceleration
  - Prepare a good initial guess for the Newton-Raphson method



TCAD acceleration (GIST)

Recent applications (4)

- Compact model
  - BSIM-CMG is a standard model.
  - Recently, BSIM-NN is developed.



Compact model (Alsemy)

MNIST dataset of handwritten digits

- We can download it.
  - The original one, https://yann.lecun.com/exdb/mnist/, do now allow downloading.
  - MNIST in CSV (https://git-disl.github.io/GTDLBench/datasets/mnist_datasets/)

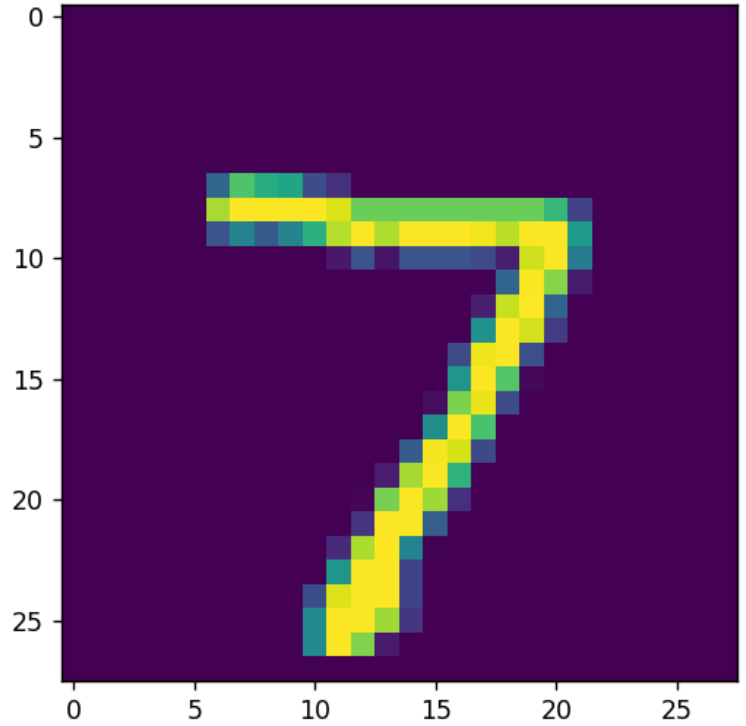
It's 7.

They are placed in the same row. 0 represents white while 255 represents black.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Homework#8

- Due: AM08:00, October 10
- Problem#1
  - Download the MNIST dataset. For your later use, visualize one of them.
  - For example, one of them looks like:



Thank you for your attention!