Unit 3: Programming with Relations

Spreadsheets	SQL Relational algebra	Graph Query Languages	Datalog Prolog

Pandas
CSVs

— Formulas

Cell

Row

Column
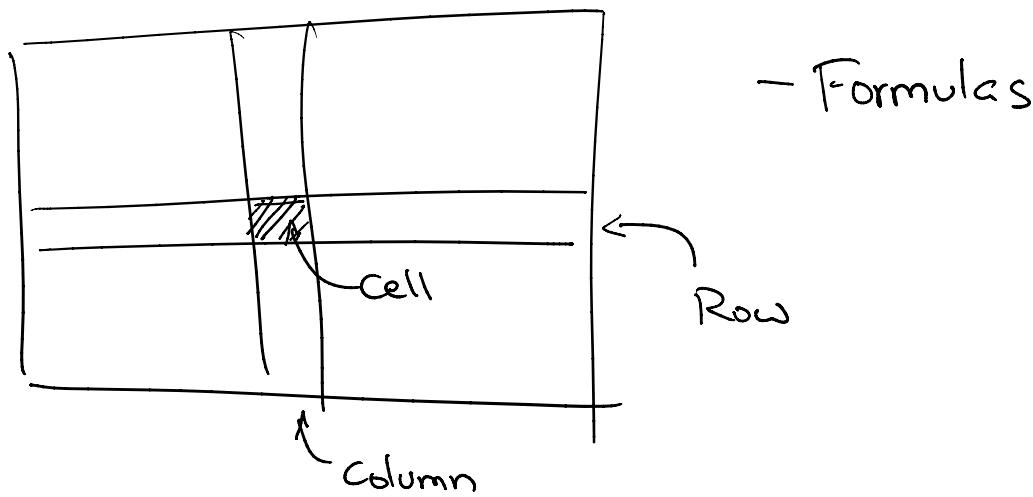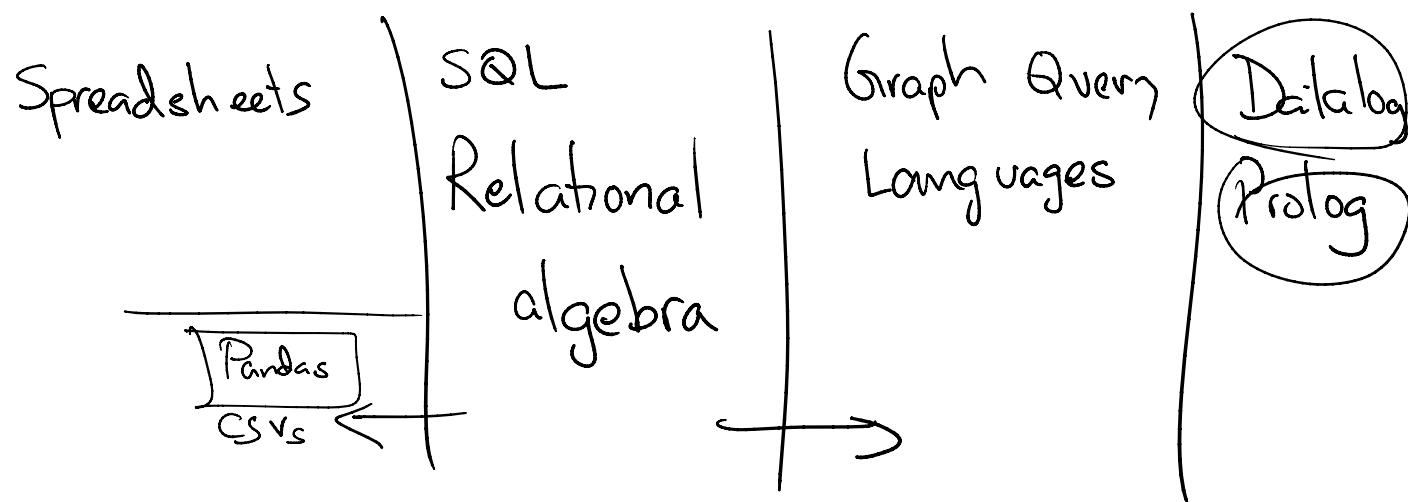
Observation: If there are circular references, then Excel complains.
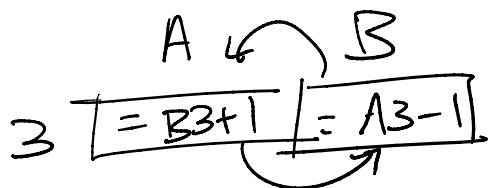
```
      A       B
   ┌──────┬──────┐
 3 │ = B3+1│ = A3-1│
   └──────┴──────┘

      5       4

      7       6
```

Opposite Question: When does Excel not complain?

When is a spreadsheet "well-formed"?

— All cells must be syntactically well formed.

— References should form a DAG

Directed Acyclic Graph

Makefiles

target : dependencies

recipe

The graph of
dependencies → target

— Stateless electronic circuits

Combinatorial logic
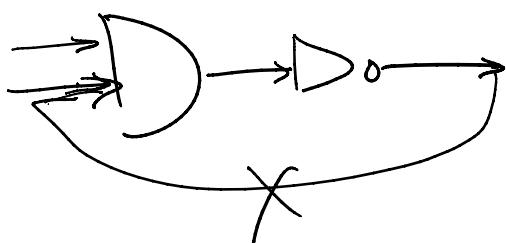
dependencies ⟶ target [1]
must form a DAG.

What are _pointers_? Or the equivalent of
pointers?

LOAD 0x5e8a : Load the contents of address
0x5e8a into the accumulator

Load Indirect 0x5e8a   Fetch me the contents of
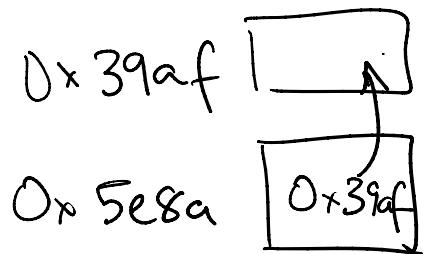
0x39af [   ]   the cell pointed to by

0x5e8a [0x39af]   address 0x5e8a.

Address ((E 15)   1   4)

⟹ Address (4   1   4)

1/A
1
2   ⟹ A4
3
4
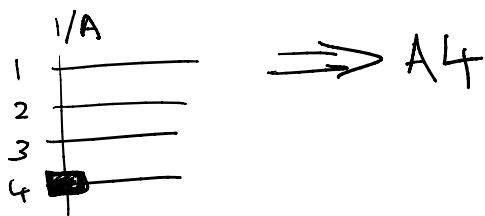
Address $(E16 \quad 1 \quad 4)$

$\Rightarrow$ Address $(5 \quad 1 \quad 4)$

$\Rightarrow$ A5

```
   1/A
1 ├────────
2 ├────────→
3 ├────────
4 ├────────
5 ▨├────────
```