CSCI 241

Scott Wehrwein

Giraffes: Introduction, Definition

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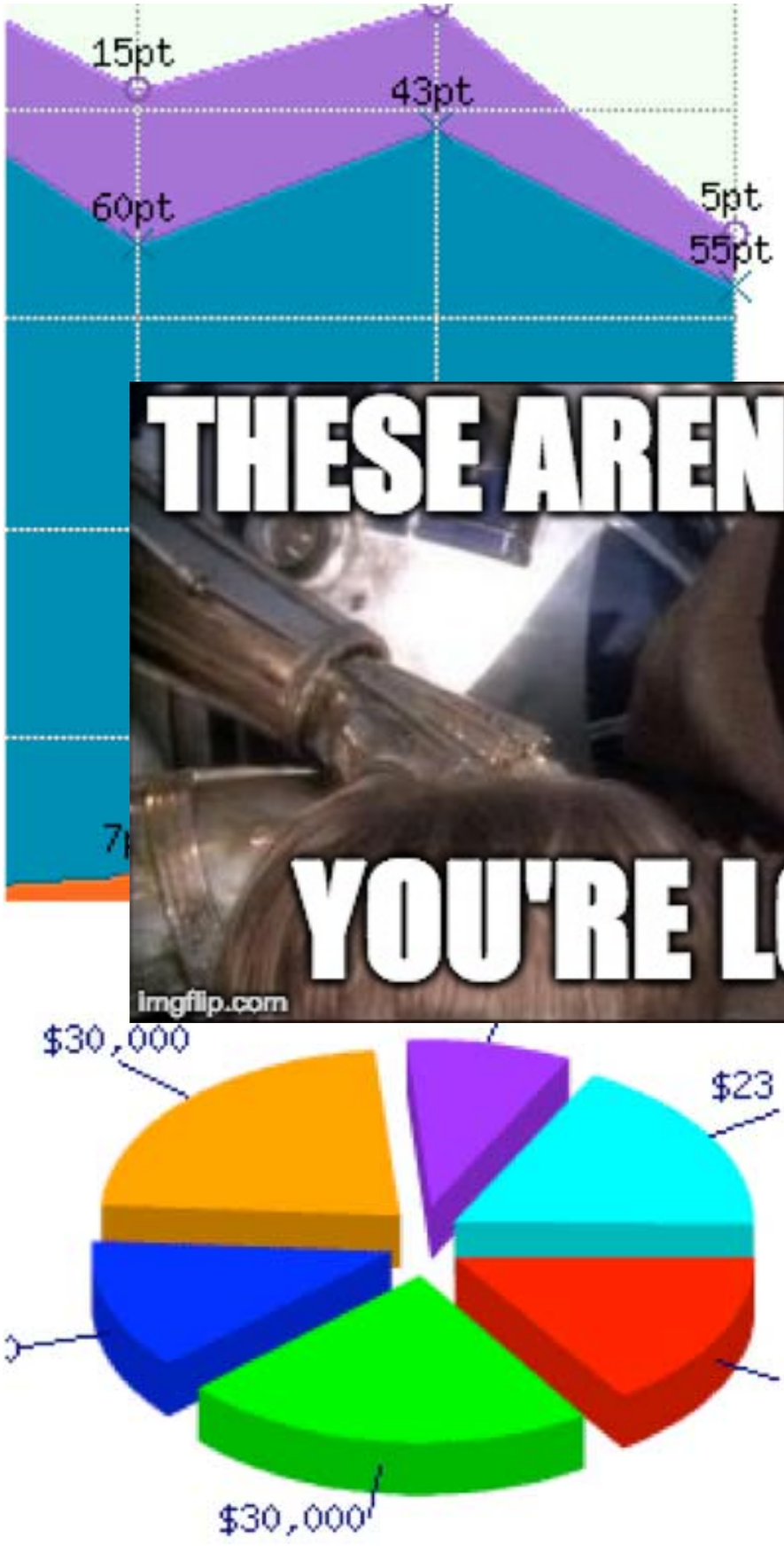
Graphs: Introduction, Definition, Terminology

Goals

Know what computer scientists mean when they talk about graphs.


15pt
43pt
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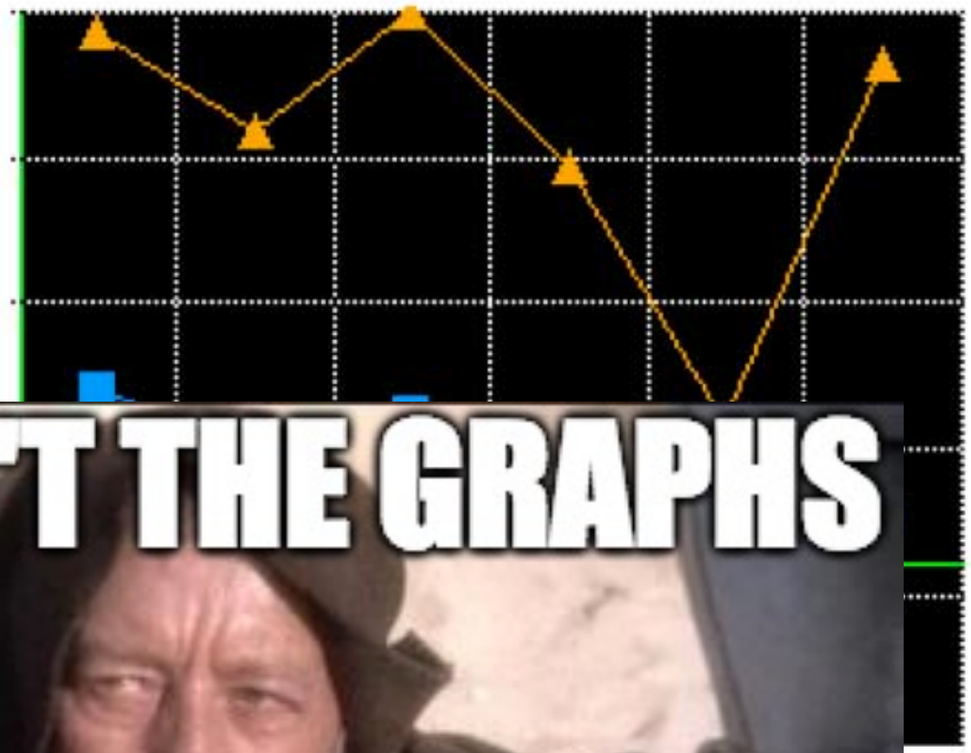
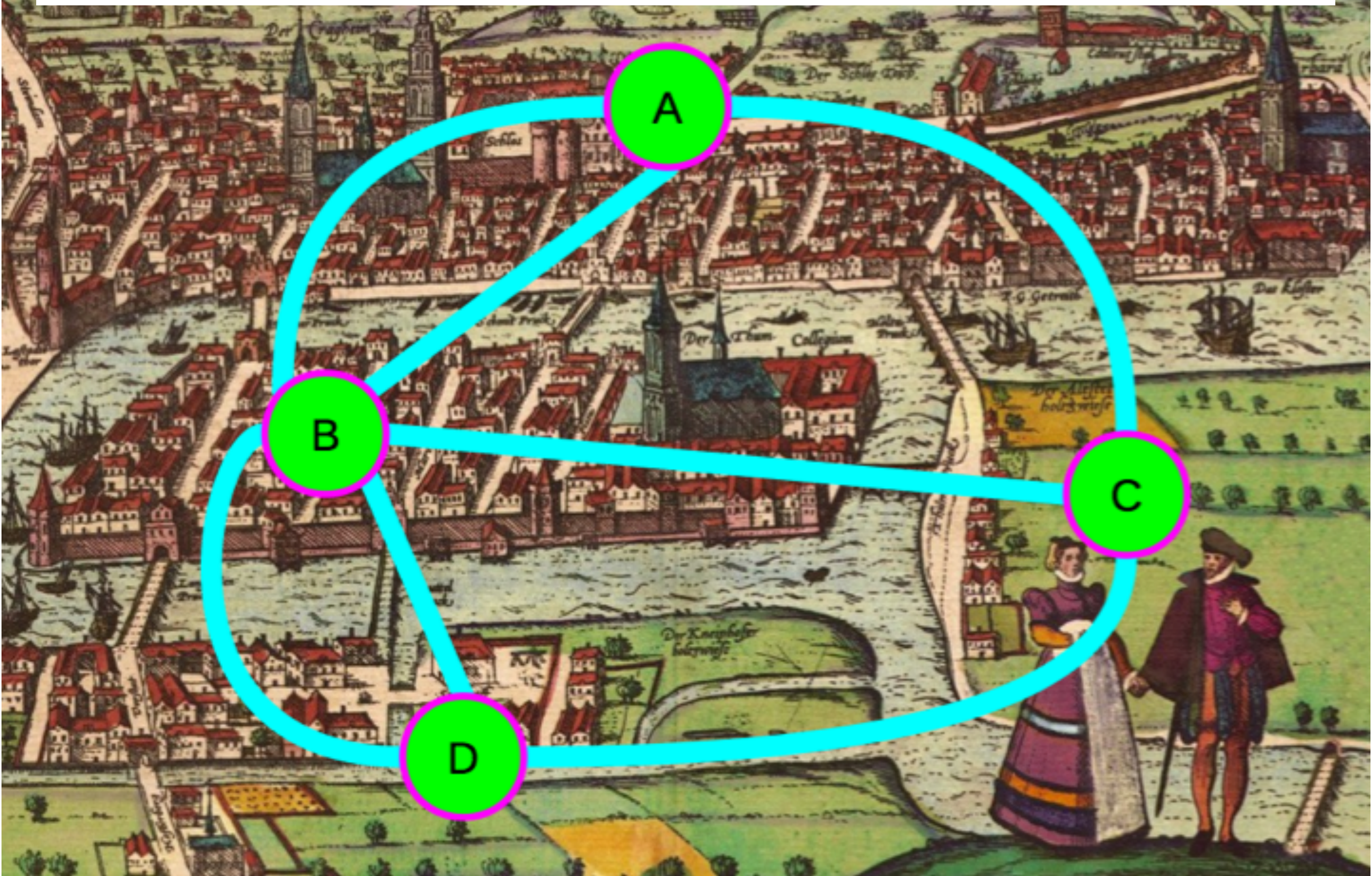


THESE AREN'T THE GRAPHS
YOU'RE LOOKING FOR
imgflip.com

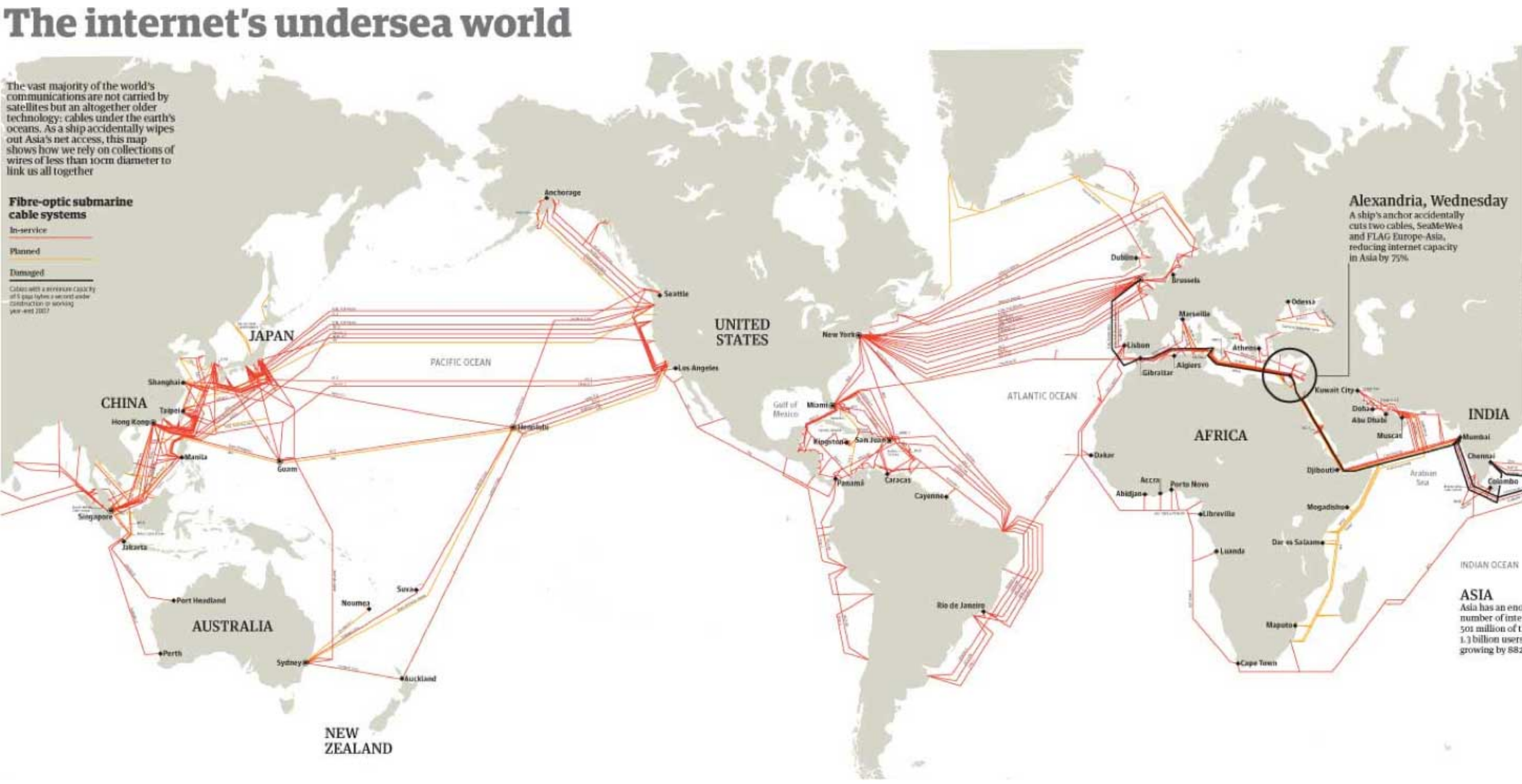
$30,000
$23
$30,000

$374
$343
$429
$150
$100
$130
$124
$75
$-60
$-150

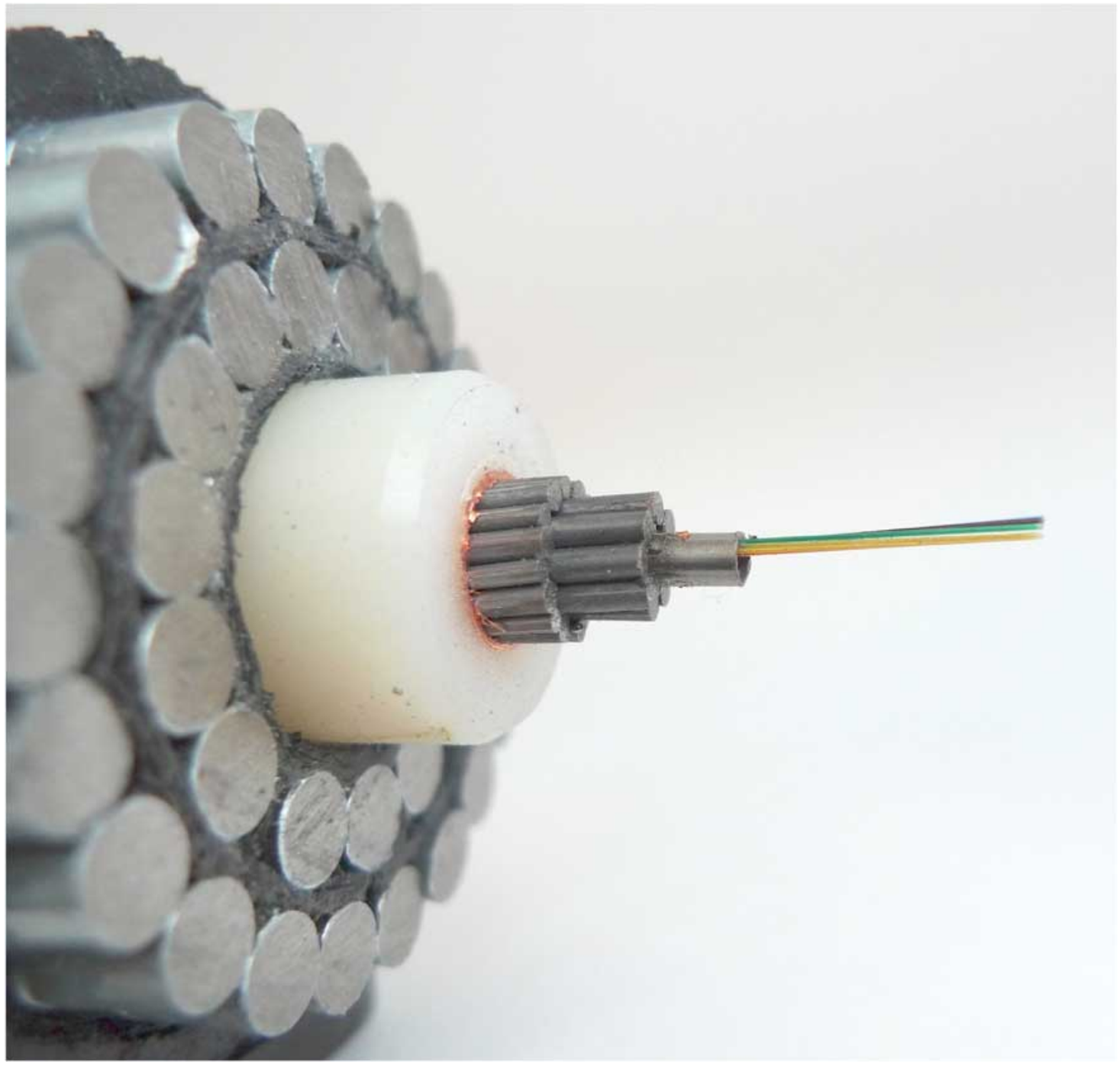
Graph: a bunch of points connected by lines.
The lines may have directions, or not.



This is a graph:

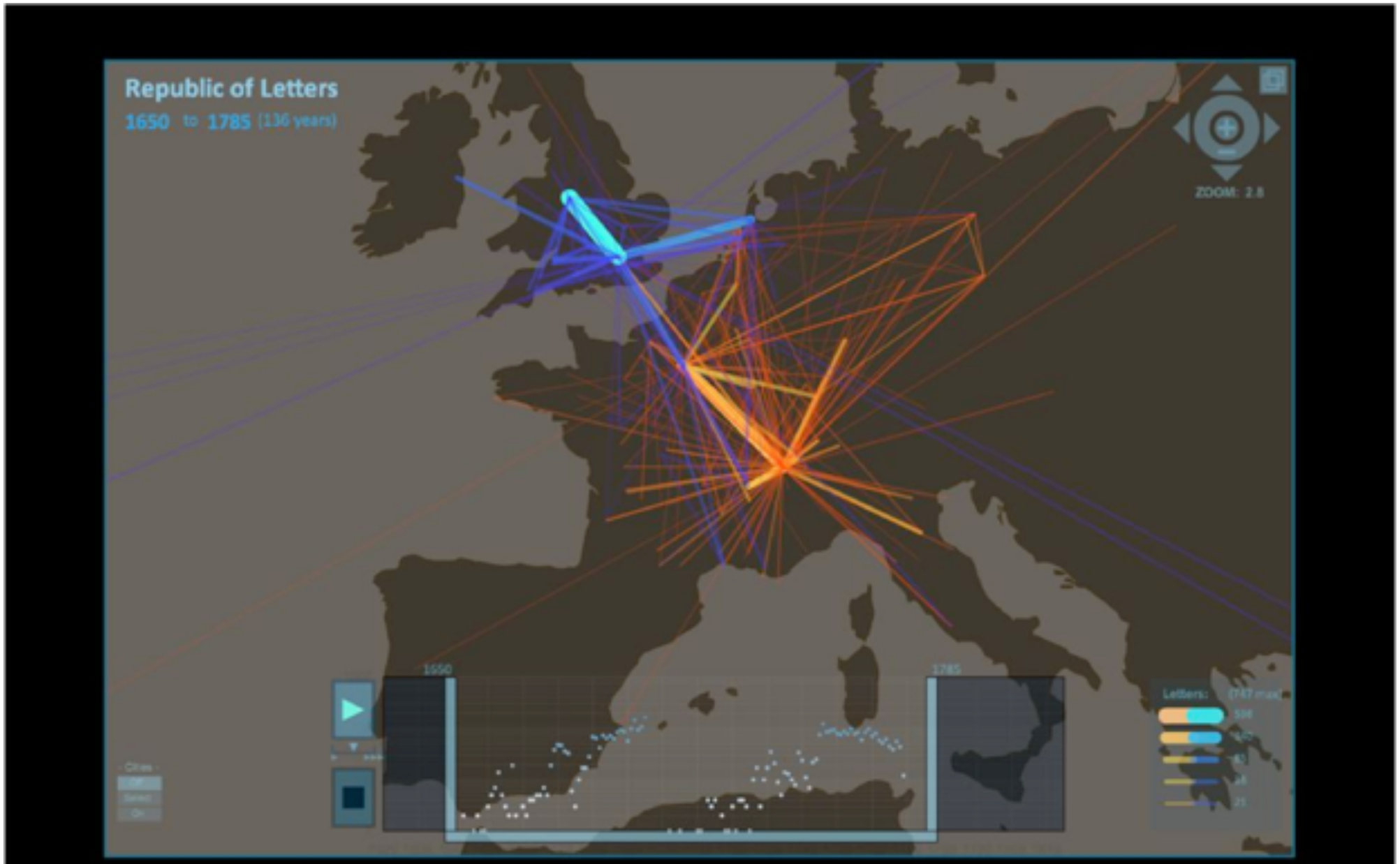


The edges are made of these:



Social Networks

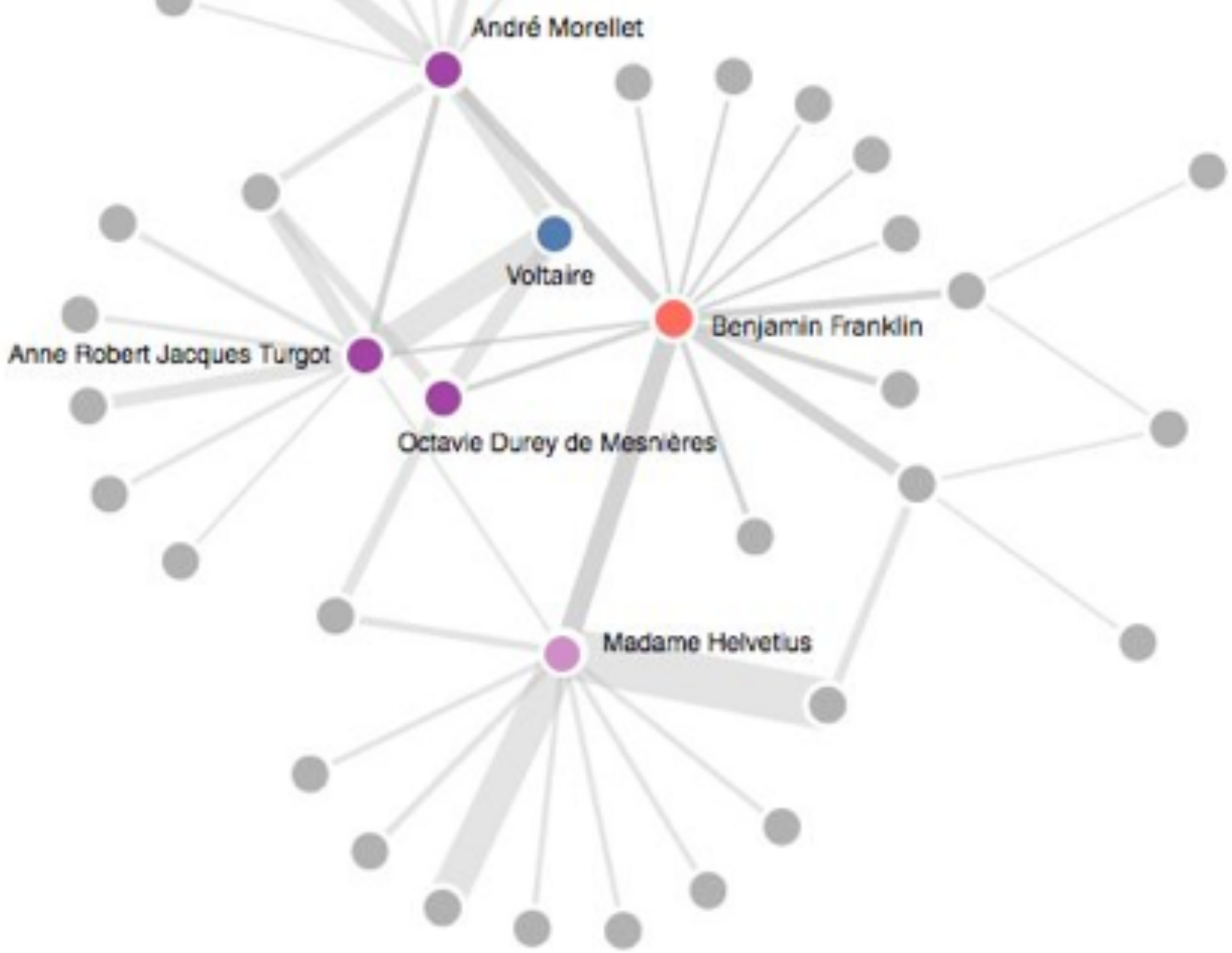
(before they were cool)



Locke's (blue) and Voltaire's (yellow) correspondence.
Only letters for which complete location information is available are shown.
Data courtesy the Electronic Enlightenment Project, University of Oxford.

Social Networks

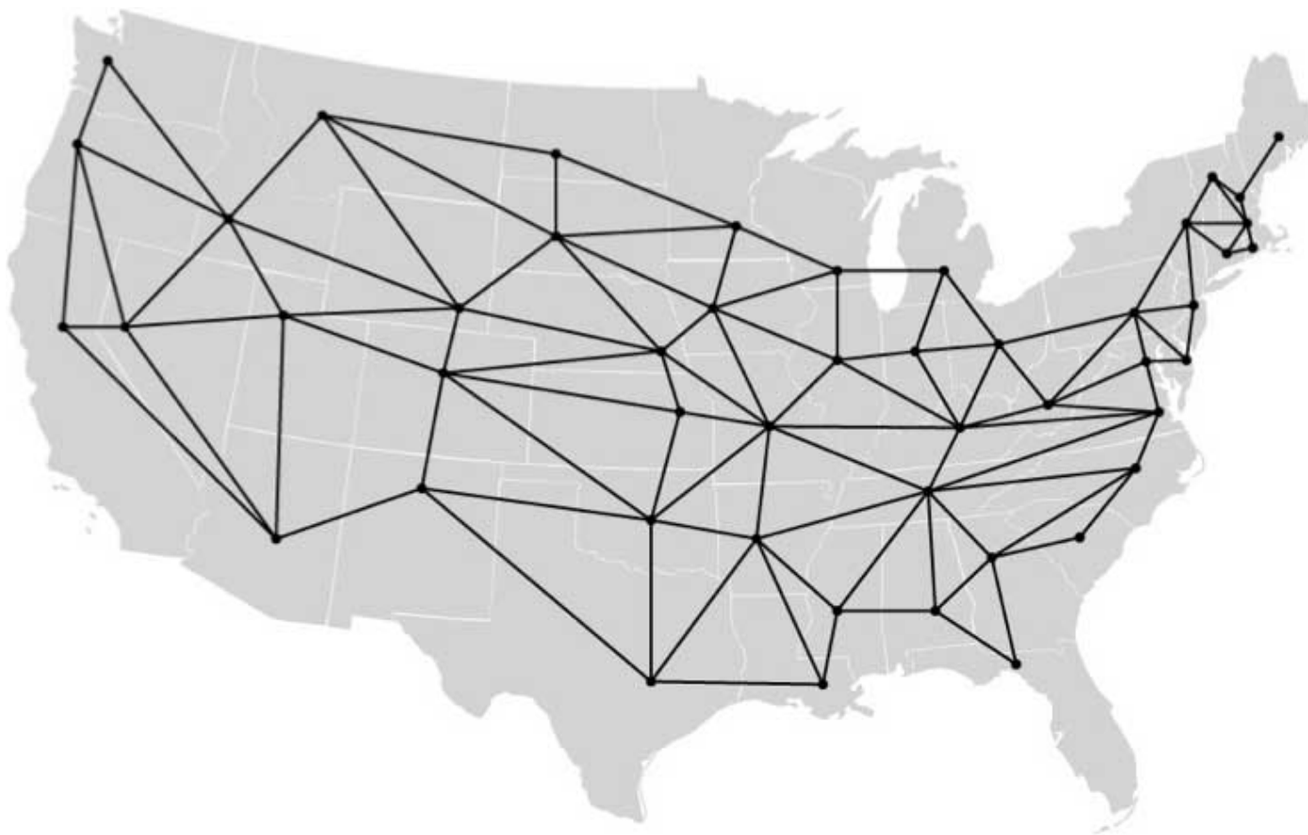
(before they were cool)

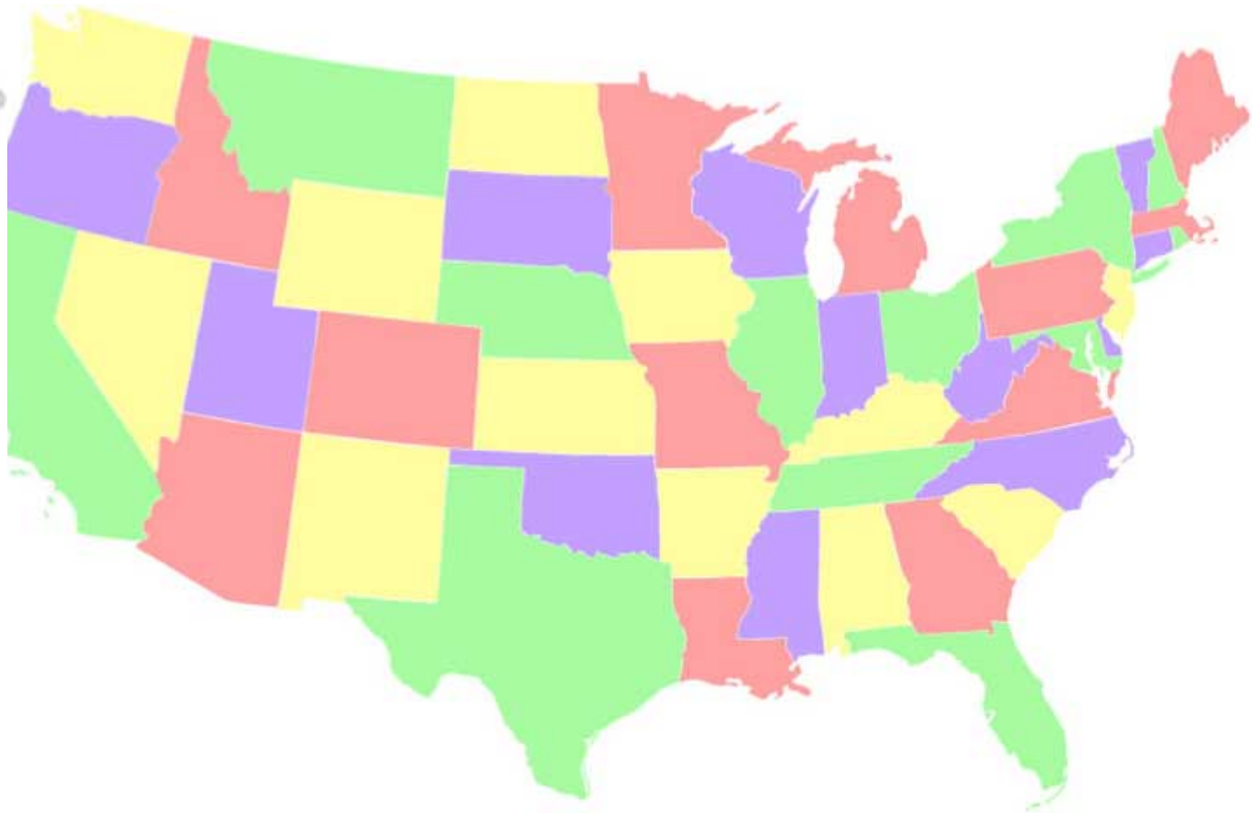


Aurora
2021
Greenwood
Licton Springs
Lake Washington
Crown Hill
85th/Aurora
Roosevelt
2021
Sand Point
NW 65th St
Green Lake
West Woodland
Wallingford
U District
2021
Children's Hospital
Ballard
2035
Phinney / Zoo
U Village
Fremont
University of Washington
Interbay
2035
Aloha
Lake Union
Lower Queen Anne
2035
Madison Park
15th/ Thomas
Expedia
2035
Capitol Hill
23rd / Madison
South Lake Union
2035
12th / Madison
Denny Way
2035
First Hill
Westlake
Midtown
2035
E Cherry St
Puget Sound
University St
S Jackson St
Pioneer Square
International District
King Street Station
Judkins Park
2023
Mercer Island
2023
Actual Stadium
2030
Stadium
SODO
Starbucks
2030
Beacon Hill
North Delridge
2030
Mount Baker
Avalon
2030
Columbia City
Georgetown
S Graham St
2031
Alaska Junction
2030
Othello
South Park
Morgan Junction
Rainier Beach
Boeing Access Rd
2031
Westwood Village
Tukwila International Blvd
Downtown Renton
White Center
Burien
Southcenter
Tukwila
SeaTac / Airport

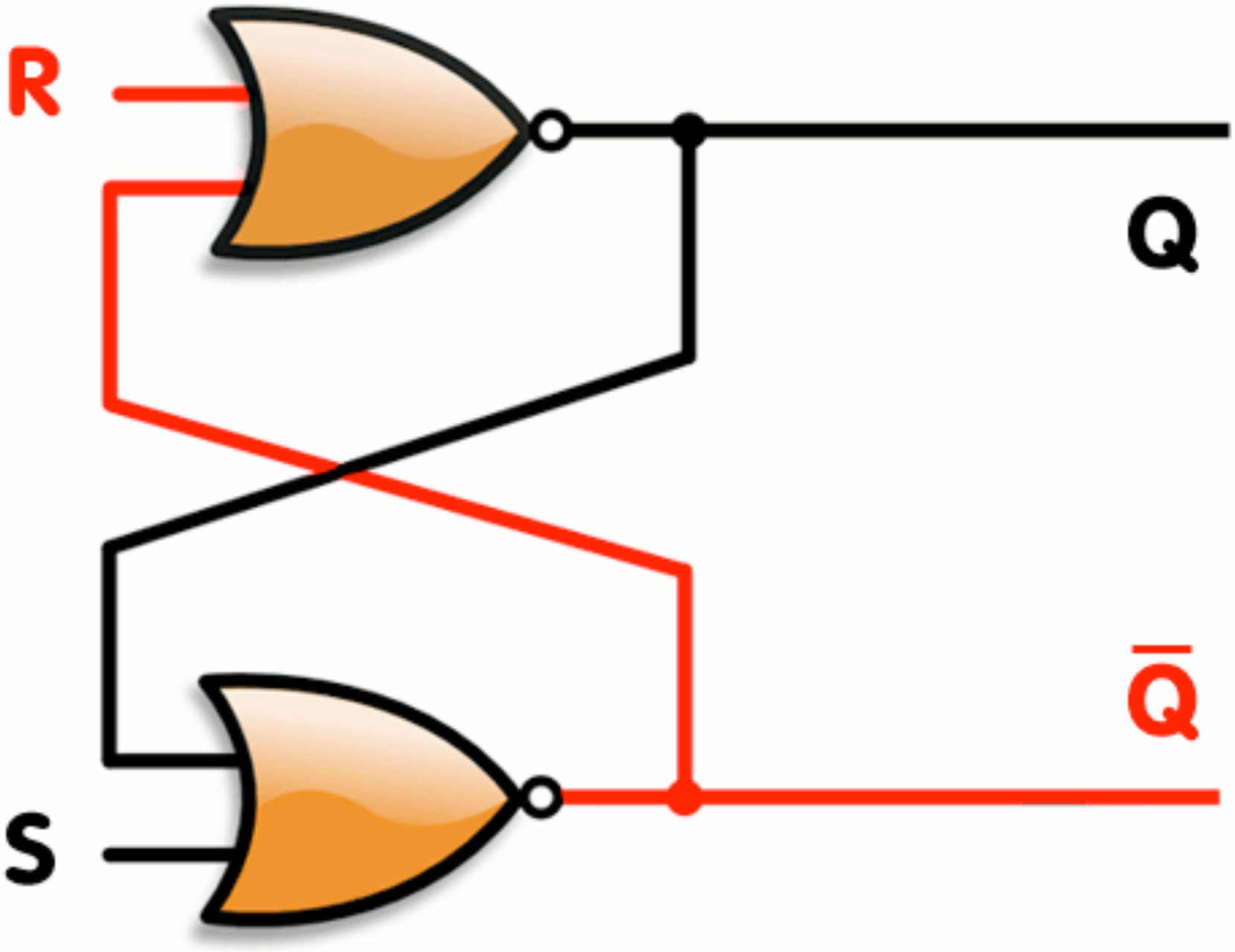
The USA as a graph:

Neighboring states are connected by edges.

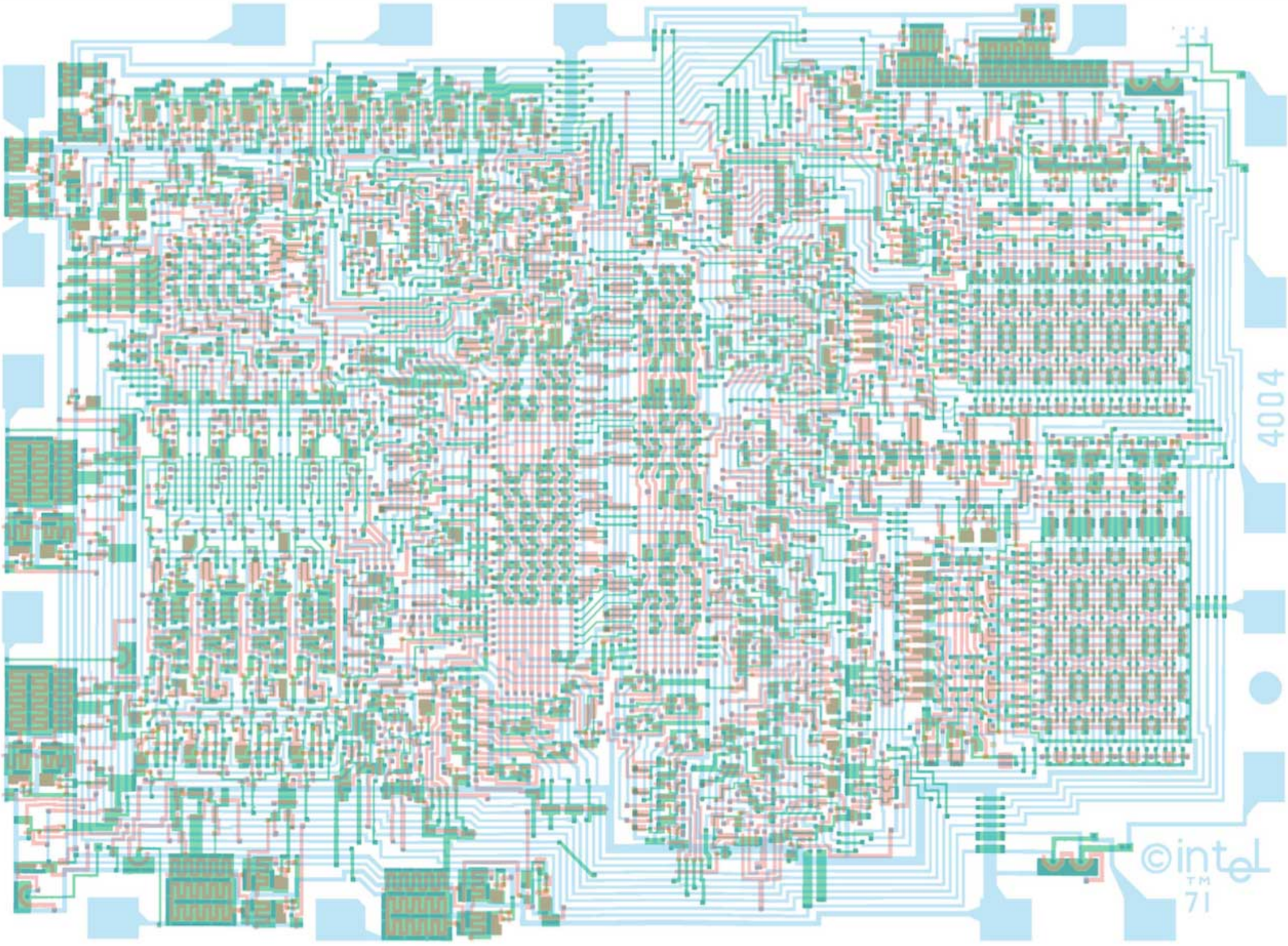




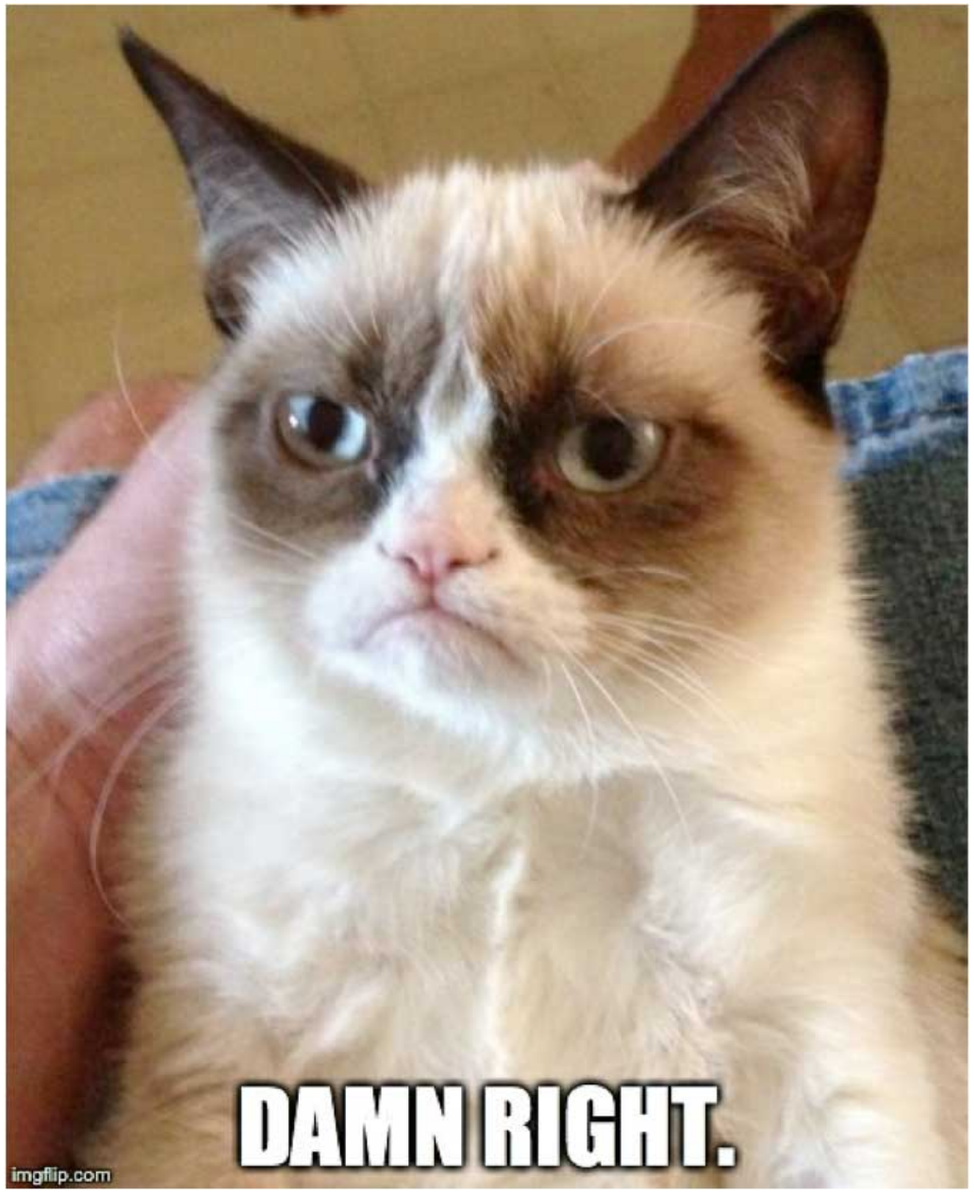
Electrical circuit as a graph



A bigger electrical circuit

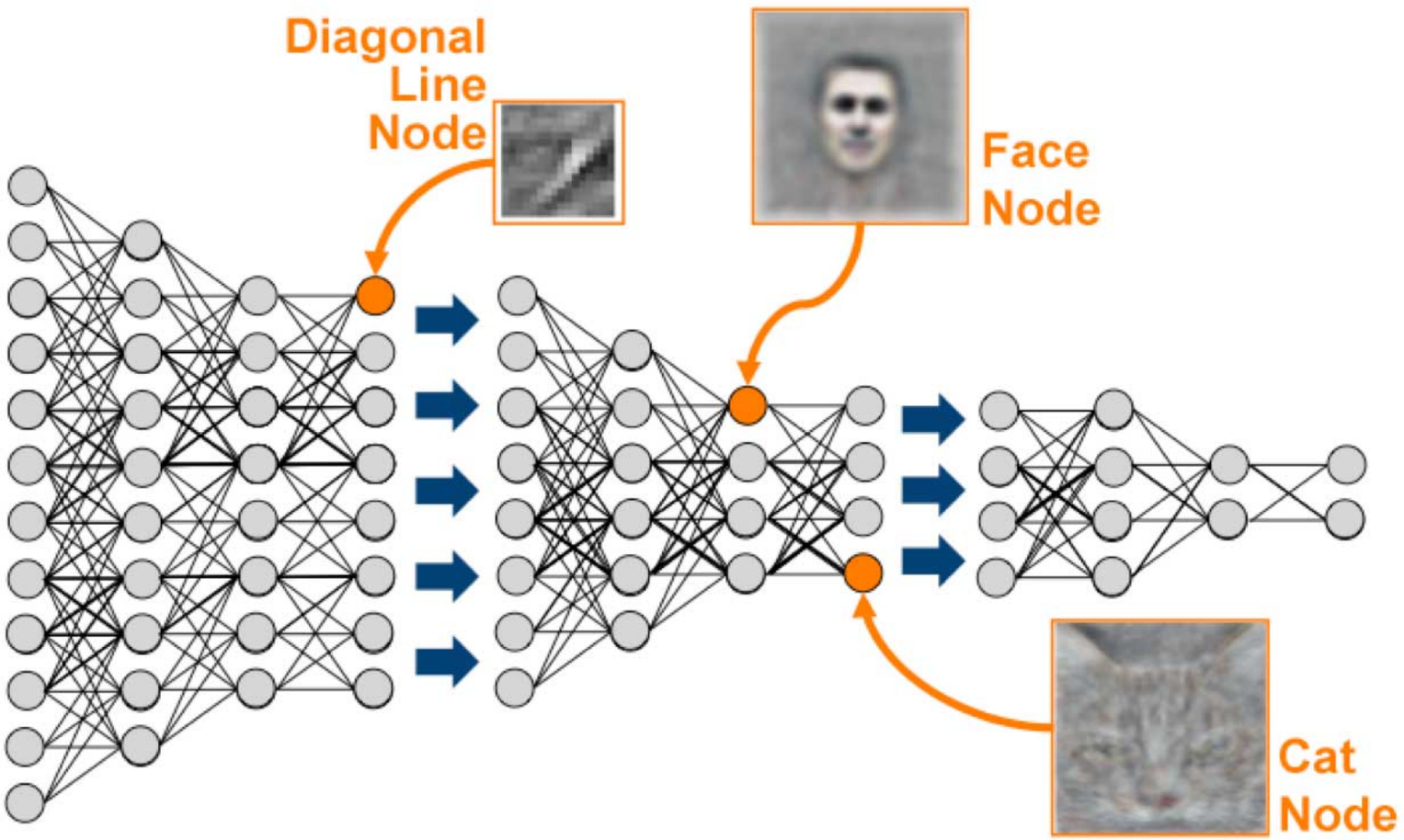


This is not a graph:



it is a cat.

This is a graph

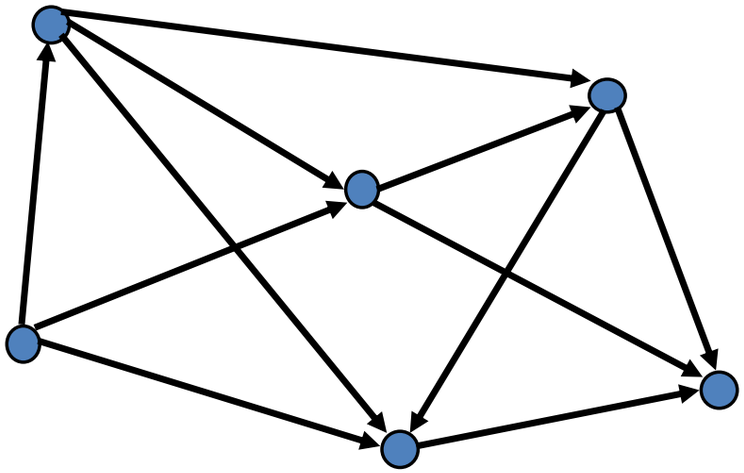


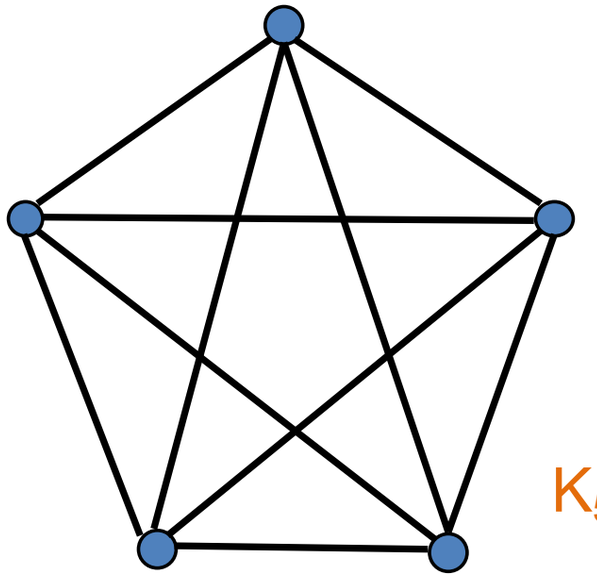
that can recognize cats.

Graphs: The Abstract View

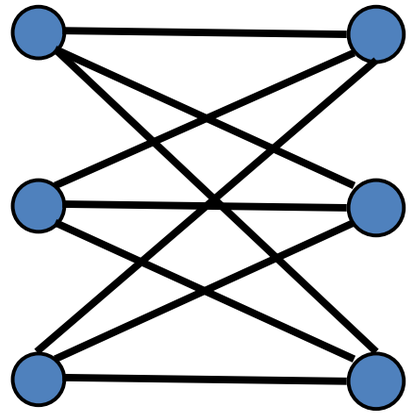
Graph: a bunch of points connected by lines.

The lines may have directions, or not.

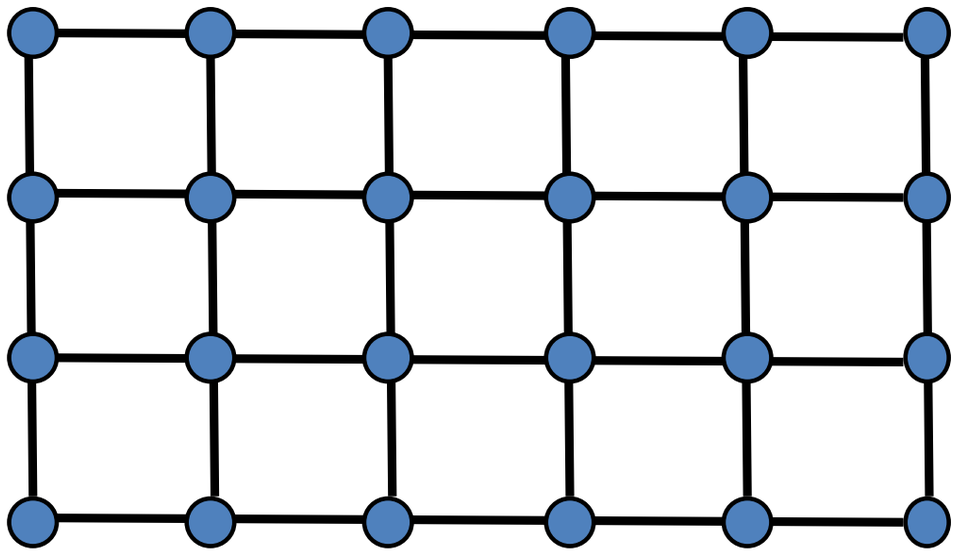


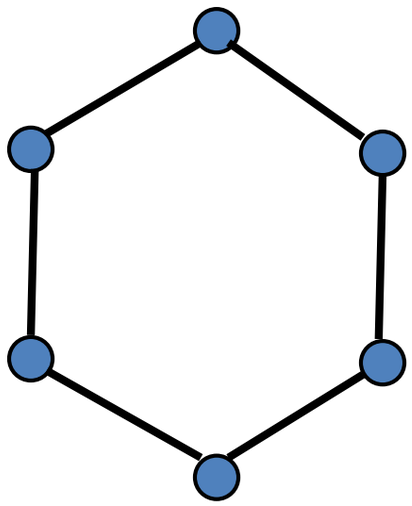


K_5



$K_{3,3}$





Graphs, Formally

A directed graph (digraph) is a pair (**V**, **E**) where:

- **V** is a (finite) set
- **E** is a set of **ordered** pairs (u, v) where u, v are in **V**
  - Often (not always): u ≠ v
    (i.e., no edges from a vertex to itself)

An element in **V** is called a vertex or node

Elements in **E** are called edges or arcs

|**V**| = size of **V** (traditionally called n or v)

|**E**| = size of **E** (traditionally called m or e)

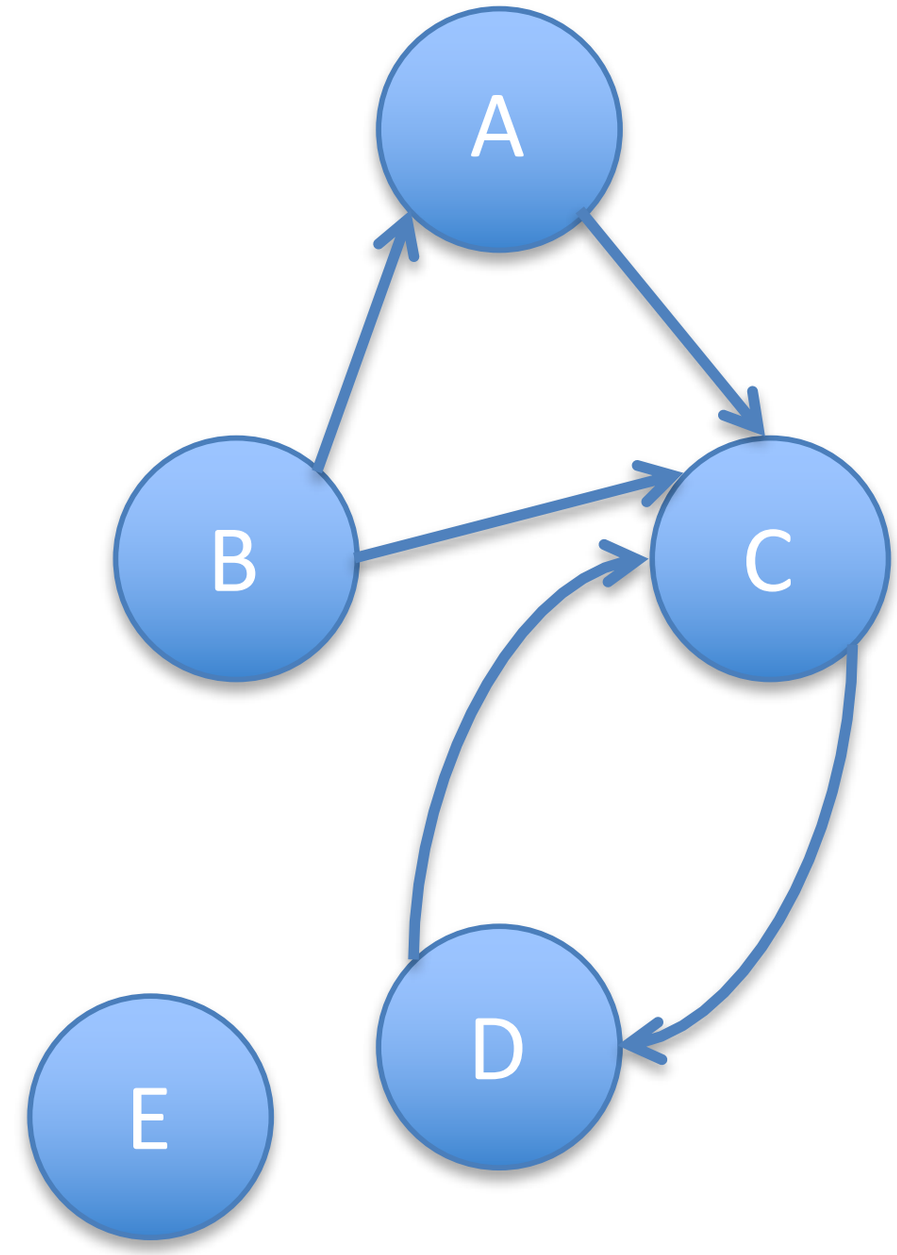
An example directed graph

V = {A, B, C, D, E)

E = {(A, C), (B, A), (B, C),
(C, D), (D, C)}

|**V**| = 5

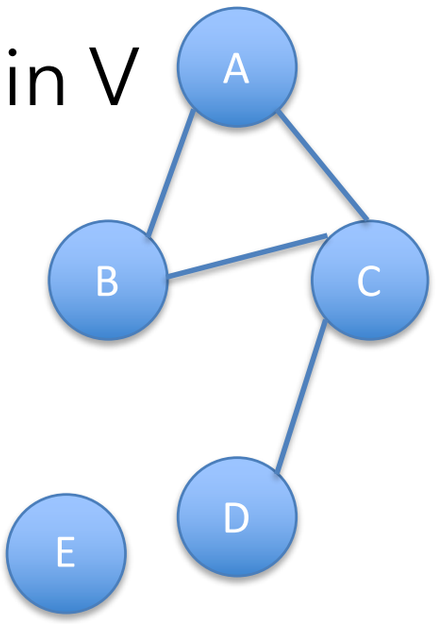
|**E**| = 5



Graphs, Formally

An **un**directed graph is a just like a digraph, but

- E is a set of **un**ordered pairs (u, v) where u, v are in V



V = {A, B, C, D, E}

E = {(A, C), (A, B), (B, C), (C, D)}

|**V**| = 5 |**E**| = 4

Any **un**directed graph has an equivalent **directed** graph:

- Replace each undirected edge with two directed edges

A **directed** graph doesn't always have an equivalent **undirected** graph.