#### Chapter 6 Graphs

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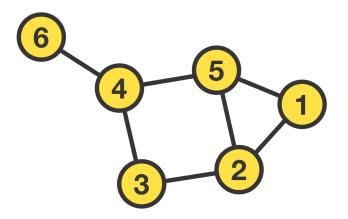
Computer Science Fundamentals (Source: brilliant.org)

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#### The Road Ahead...

- ► Graphs are one of the most important mathematical concepts used in computer science
- What we'll accomplish
  - define graphs in terms of vertices and edges

# Data Structure: Graphs



- ▶ Graph G = (V, E): a set of V vertices (nodes) & a set of E edges; each edge connects two vertices
- ► Applications: GPS navigation (Google Maps), social media network (Facebook), etc.

# Python Code

Representation using adjacency lists

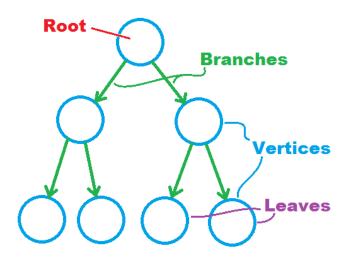
```
class Graph:
def __init__(self,size):
    self.size = size
    #label n vertices 0 through n-1
    self.vertices = [[] for i in range(size)]
#each vertex has a list of vertices it is
   connected to
def addEdge(self,i,j):
    if not (i in self.vertices[j]):
        self.vertices[j].append(i)
        self.vertices[i].append(j)
def numEdges(g):
    count = 0
    for i in range(g.size):
        count = count + len(g.vertices[i])
    return int(count/2)
```

#### Directed vs. Undirected Graphs



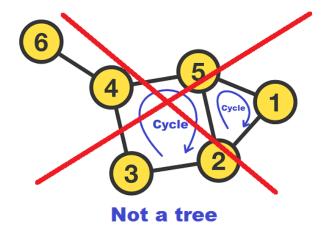
- ► Undirected (left): bidirectional relation b/w nodes, represented by a line (edge) with no arrows
- Directed (right): unidirectional relation b/w nodes, represented by an arrow (arc)

#### Data Structure: Trees



► Graphs where any two vertices are connected by exactly one path (# vertice = # edge +1)

# Data Structure: Trees (Cont'd)



► Trees cannot have loop/cycle