# STAT110 PS2

Nicholas DeSanctis

September 2022

## Lecture 9

**Definitions** —

**Directed Graph**

- Defined as G = (V, E)
- For each $(u, v) \in E$, $u, v \in V$, $u$ "points to" $v$

**Undirected Graph**

- Defined as G = (V, E)
- For each $(u, v) \in E$, $u, v \in V$, $u$ and $v$ "point to each outer"

**Digraph**

- Simple, unweighted, directed graph

**Keywords** —

*Planar*: a graph can be drawn in 2D with no edge crossings.

*Walk*: a sequence of verticies from $s$ to $t$

*Shortest Walk*: the "distance" of $s$ to $t$ (aka, the minimum of the possible lengths)

**Theorems and Lemmas** —

*Shortest Walk Lemma:* If $w$ is a shortest walk from $s$ to $t$, then all of the vertices that occur on w are distinct. That is, every shortest walk is a *path*.

- Suppose we have a shorest walk with repeated vertices. We know there exists a shorter one by simply getting rid of all vertices between the first instance of the repeated vertex and the second for all vertices.

**Algorithms** —

*Shortest Walk*

- Inputs: digraph $G = (V, E)$, verticies $s, t \in V$
- Outputs: shortest walk iff it exists
- Possible solving algorithms:
  1. Exhaustive Search: $(n-1)! \cdot O(n)$
     - Get all walks of length n-1
     - By Shortest Walk Lemma, our shortest walk must be here
     - Find shortest walk starting from $s$ and ending at $t$
  2. BFS: