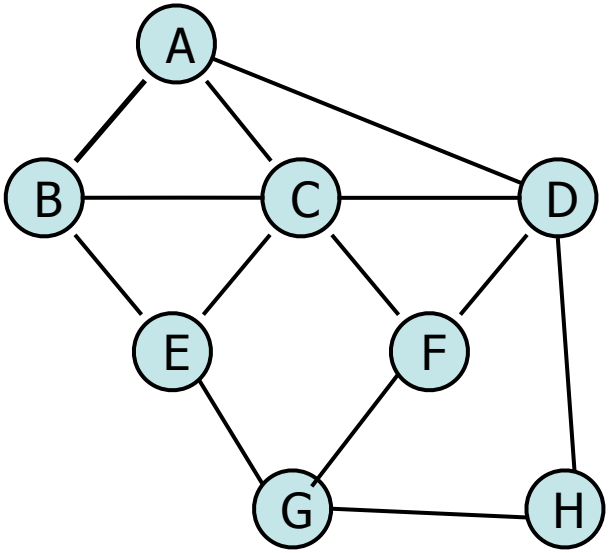
# Today's announcements:

MP7 available, due 4/30, 11:59p.

## Graphs: BFS example



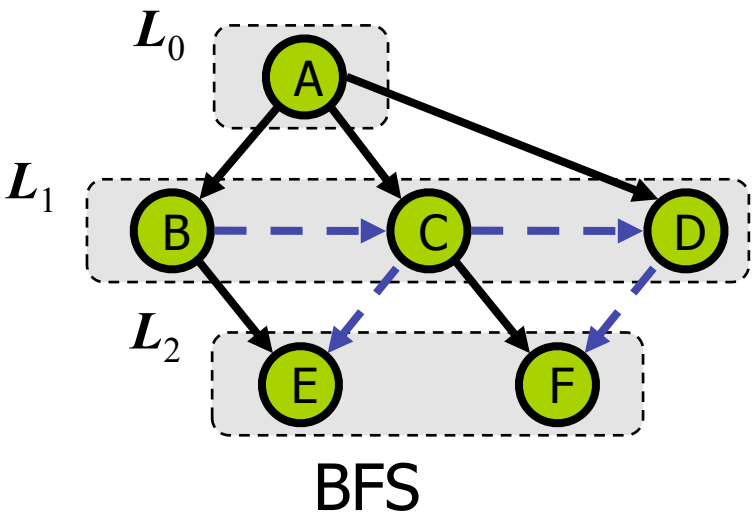

| | |
|---|---|
| A | C B D |
| B | A C E |
| C | B A D E F |
| D | A C F |
| E | B C G |
| F | C D G |
| G | E F H |
| H | D G |

While loop

For loop

TOTAL RUNNING TIME:

# Graphs: BFS properties




BFS

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- 

# Graphs: Traversal - DFS

Ariadne, Theseus, and the Minotaur

http://www.cs.duke.edu/csed/jawaa2/examples/DFS.html

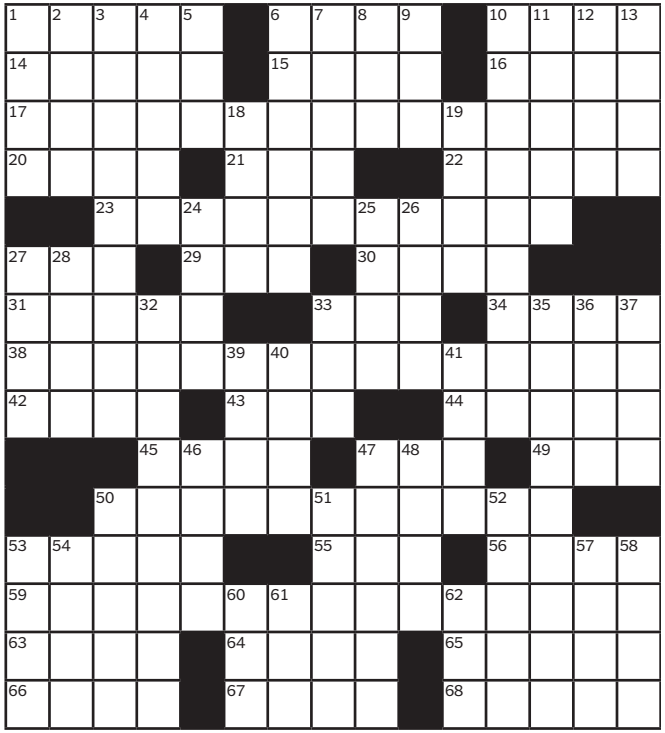
http://www.student.seas.gwu.edu/~idsv/idsv.html

http://www.youtube.com/watch?v=8qrZ1clEp-Y

# Crossword

Edited by Will Shortz

PUZZLE BY AIMEE LUCIDO



11/29/11 (No. 1129)

## ACROSS

**1** LPs and 45s
**6** Cools, as drinks
**10** Traffic components
**14** With 5-Down, where "Quiet!" is often yelled
**15** "Not guilty," e.g.
**16** Eye part
**17** Like some stickers
**20** Spicy cuisine
**21** Sweetie
**22** Make fun of
**23** Enemy of Spider-Man
**27** Identify in a Facebook photo
**29** Source of stress for a coll. senior
**30** Where shingles go
**31** Mea ___
**33** Pants part
**34** Cutlass or Delta 88
**38** Navigation aid for Hansel and Gretel
**42** Tale
**43** Thumbs-up vote
**44** Card game of Spanish origin
**45** Almanac contents
**47** Not Rep. or Ind.
**49** Wood in archery bows
**50** Degrees of separation in a Hollywood parlor game
**53** Building made of bricks
**55** Branch
**56** Branch
**59** 1976 Abba song . . . or a hint to the starts of 17-, 23-, 38- and 50-Across
**63** Prime draft status
**64** Possesses
**65** Probably will, after "is"
**66** Deborah of "The King and I"
**67** Bygone Tunisian V.I.P.'s
**68** "Get clean" program

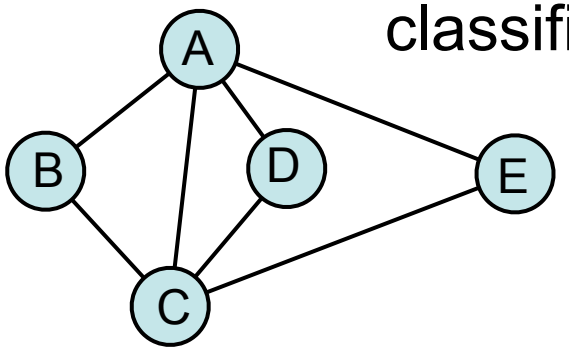
## DOWN

**1** "O mighty Caesar! ___ thou lie so low?": Shak.
**2** Move slowly
**3** One finishing a marathon in eight hours, say
**4** Leader of a meeting
**5** See 14-Across
**6** "There's an app for that" device
**7** Trolley sound
**8** Day's end, to a poet
**9** Downcast
**10** Writing with wedges and such
**11** Birdlike
**12** Ones dressed in stripes, for short
**13** Secure
**18** Often-impersonated diva
**19** Normandy battle site
**24** "Gosh almighty!"
**25** Utah city
**26** Crash and burn
**27** Franchise offering "soft serve" and "hand scooped"
**28** Subtle glow
**32** Chinese zoo attraction
**33** Color
**35** Feature of the ancient palace of Minos at Knossos
**36** Urgent
**37** Large amount
**39** Ancient Roman censor
**40** Actress Meg
**41** Tut's resting place
**46** ___-deucy (backgammon variety)
**47** Compulsion by threat
**48** TV award
**50** Screwup
**51** Mrs. Doubtfire, e.g.
**52** Run to Las Vegas, perhaps
**53** Crazedly
**54** Finished
**57** Self-referential, in modern lingo
**58** Like many restaurants without a liquor lic.
**60** Like some '60s fashion
**61** Run a tab
**62** Disfigure

## ANSWER TO PREVIOUS PUZZLE

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| F | L | O | W | ■ | I | M | A | C | ■ | H | A | D | A | T |
| D | I | D | I | ■ | S | A | R | A | ■ | O | B | E | S | E |
| A | M | O | S | ■ | O | N | A | N | ■ | F | I | C | H | E |
| ■ | P | R | E | T | T | Y | B | O | Y | F | L | O | Y | D |
| ■ | ■ | ■ | G | O | O | ■ | S | E | E | M | E | ■ | ■ | ■ |
| G | A | L | U | M | P | H | ■ | ■ | R | A | N | G | I | N |

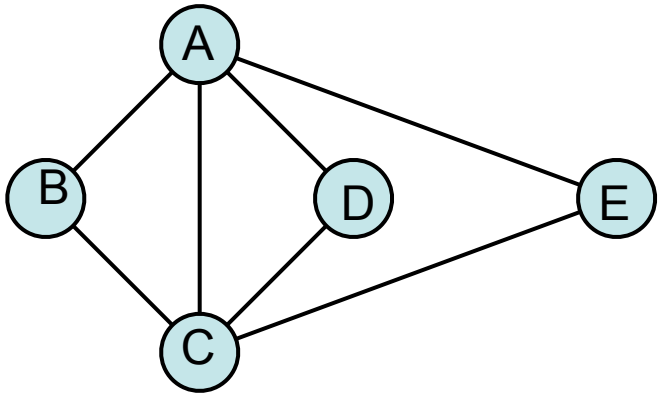
DFS: "visits" each vertex
classifies each edge as either "discovery" or "back"




```
Algorithm DFS(G)
    Input: graph G
    Output: labeling of the
      edges of G as discovery
      edges and back edges

For all u in G.vertices()
  setLabel(u, UNEXPLORED)
For all e in G.edges()
  setLabel(e, UNEXPLORED)
For all v in G.vertices()
  if getLabel(v) = UNEXPLORED
    DFS(G,v)
```

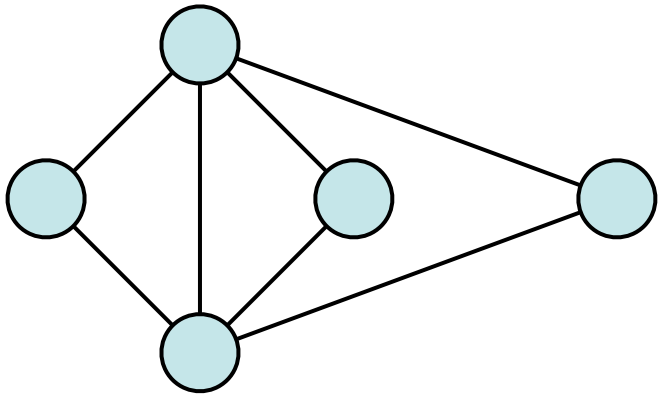
```
Algorithm DFS(G,v)
    Input: graph G and start vertex v
    Output: labeling of the edges of G in
      the connected component of v as
      discovery edges and back edges

setLabel(v, VISITED)
For all w in G.adjacentVertices(v)
    if getLabel(w) = UNEXPLORED
      setLabel((v,w),DISCOVERY)
      DFS(G,w)
    else if getLabel((v,w)) = UNEXPLORED
      setLabel(e,BACK)
```

# Graphs: DFS example




| | |
|---|---|
| A | B C D E |
| B | A C |
| C | B A D E |
| D | A C |
| E | A C |

# Graphs: DFS Analysis



setting/getting labels

every vertex labeled twice

every edge is labeled twice

querying vertices

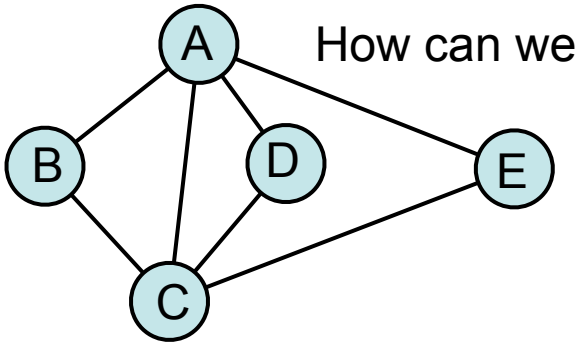
each vertex

total over algorithm

querying edges

TOTAL RUNNING TIME:

DFS: How can we count the number of connected components in the graph?




How can we determine if a graph has a cycle?

```
Algorithm DFS(G)
    Input: graph G
    Output: labeling of the edges of G as discovery edges and back edges

For all u in G.vertices()
  setLabel(u, UNEXPLORED)
For all e in G.edges()
  setLabel(e, UNEXPLORED)
For all v in G.vertices()
  if getLabel(v) = UNEXPLORED
    DFS(G,v)
```

```
Algorithm DFS(G,v)
    Input: graph G and start vertex v
    Output: labeling of the edges of G in the connected component of v as discovery edges and back edges

setLabel(v, VISITED)
For all w in G.adjacentVertices(v)
    if getLabel(w) = UNEXPLORED
      setLabel((v,w),DISCOVERY)
      DFS(G,w)
    else if getLabel((v,w)) = UNEXPLORED
      setLabel(e,BACK)
```