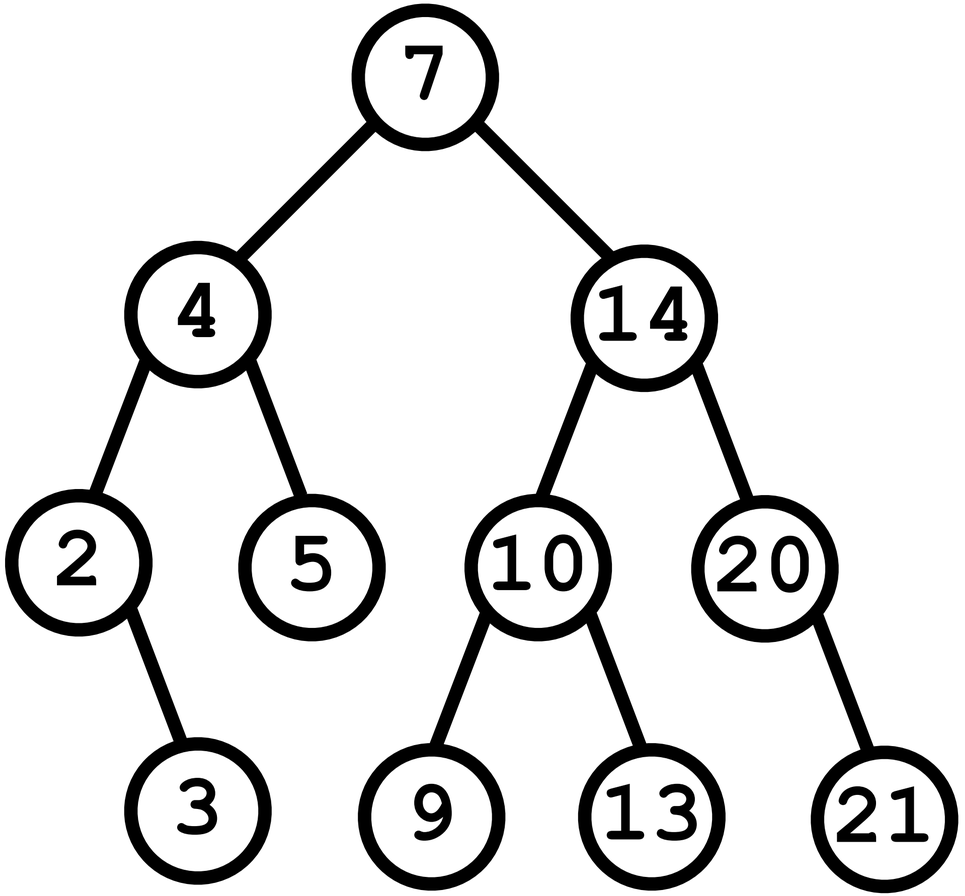
# COSC 2436: Final Exam Review

J. Eoin Donovan - 2023

# BST #1

**Write the traversal name under each different type of traversal.**



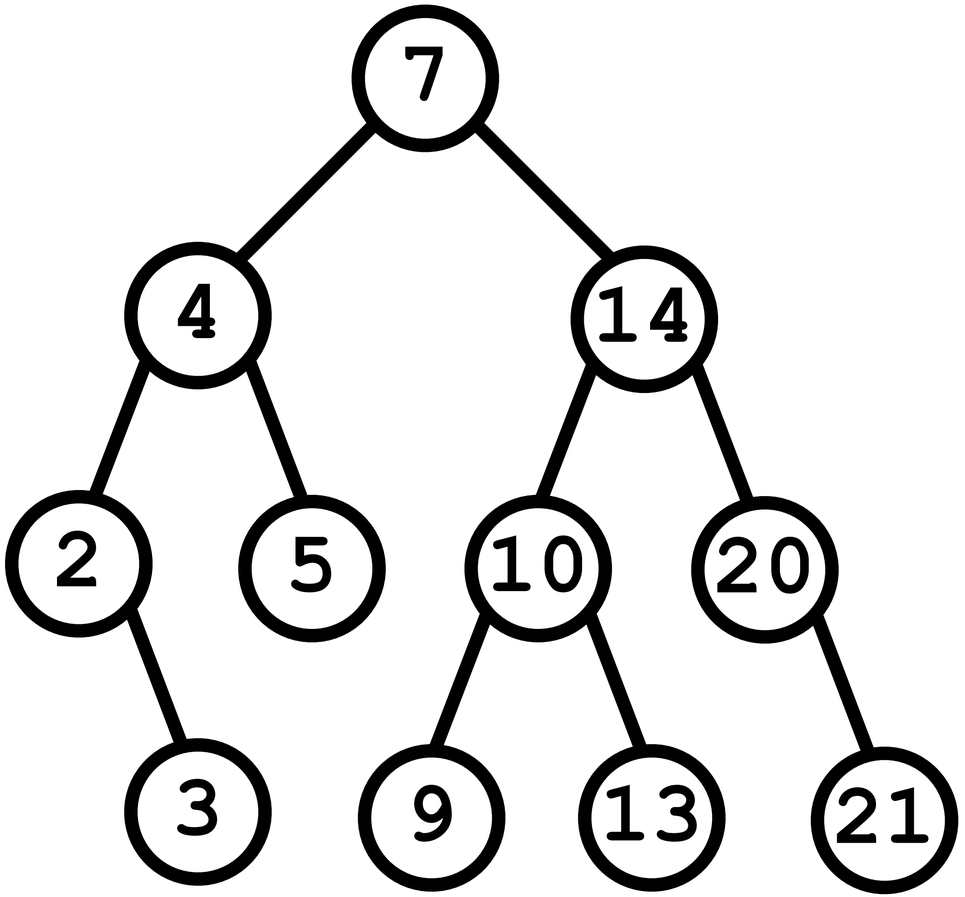

**3, 2, 5, 4, 9, 13, 10, 21, 20, 14, 7**

**2, 3, 4, 5, 7, 9, 10, 13, 14, 20, 21**

**7, 4, 2, 3, 5, 14, 10, 9, 13, 20, 21**

# BST #1

**Write the traversal name under each different type of traversal.**




3, 2, 5, 4, 9, 13, 10, 21, 20, 14, 7

**Postorder**

2, 3, 4, 5, 7, 9, 10, 13, 14, 20, 21

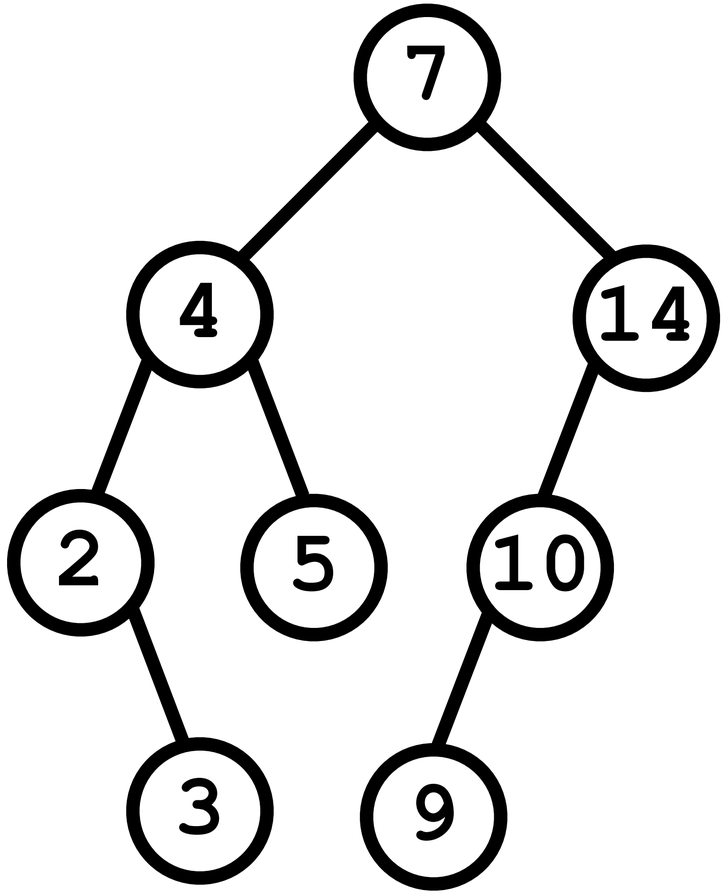
**Inorder**

7, 4, 2, 3, 5, 14, 10, 9, 13, 20, 21

**Preorder**

# BST #2

**Answer the following questions about the BST below.**




**What is the height of the BST?**

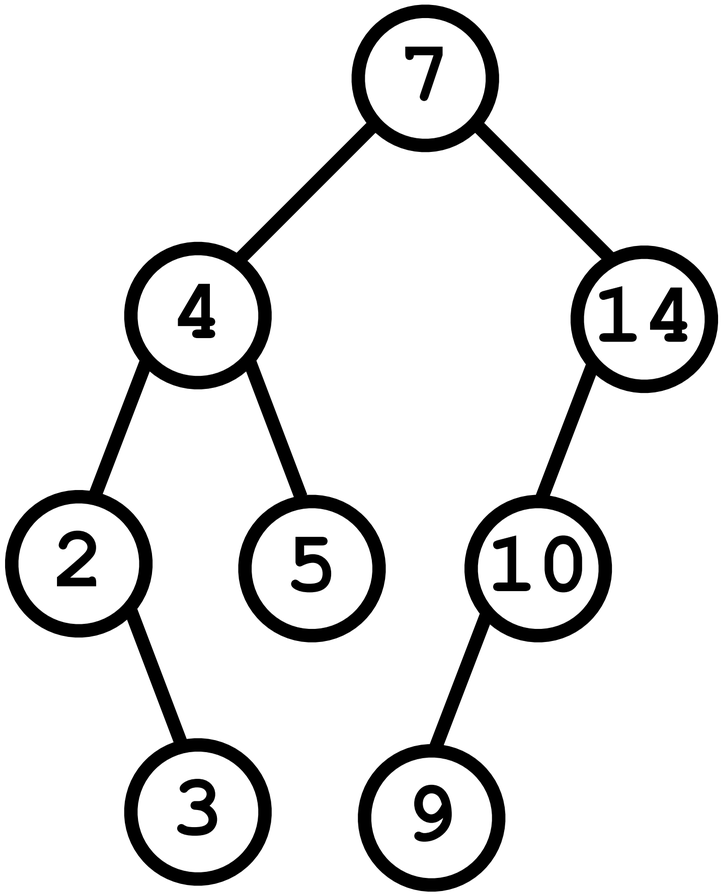
**What is the depth of node 10?**

**What is the lowest common ancestor of nodes 3 and 5?**

**What nodes make up level 3 of the BST?**

# BST #2

**Answer the following questions about the BST below.**




**What is the height of the BST?**

**3**

**What is the depth of node 10?**

**2**

**What is the lowest common ancestor of nodes 3 and 5?**

**node 4**

**What nodes make up level 3 of the BST?**

**node 2, node 5, and node 10**

# BST #3

**Complete the function `int getSize(node *root)` which returns the size (number of nodes) in a BST.**

```
struct node{
   int value;
   node *left;
   node *right;
};

int getSize(node *root){



}
```

# BST #3

```
int getSize(node *root){
  if(root == nullptr){
    return 0;
  }
  else if(root->left == nullptr && root->right == nullptr){
    return 1;
  }
  else{
    return 1 + getSize(root->left) + getSize(root->right);
  }
}
```

# BST #4

**Complete the function `node *getNode(node *root, int value)` which returns the node containing `value`. Your function must use recursion (no iteration).**

```
struct node{
  int value;
  node *left;
  node *right;
};

node *getNode(node *root, int value){



}
```

# BST #4

```
node *getNode(node *root, int value){
  if(root == nullptr){
    return nullptr;
  }
  else if(value < root->value){
    return getNode(root->left, value);
  }
  else if(value > root->value){
    return getNode(root->right, value);
  }
  else{
    return root;
  }
}
```

# BST #5

**Complete the function `node *getNode(node *root, int value)` which returns the node containing `value`. Your function must use iteration (no recursion).**

```
struct node{
  int value;
  node *left;
  node *right;
};

node *getNode(node *root, int value){



}
```

# BST #5

```
node *getNode(node *root, int value){
  while(root != nullptr){
    if(root->value == value){
      return root;
    }
    else if(root->value > value){
      root = root->left;
    }
    else if(root->value < value){
      root = root->right;
    }
  }
  return root;
}
```

# BST #6

**Complete the function `int getDepth(node *root, int value, int depth)` which finds the depth of the node containing `value`. Assume depth is passed in as 0. Return -1 if `value` does not exists.**

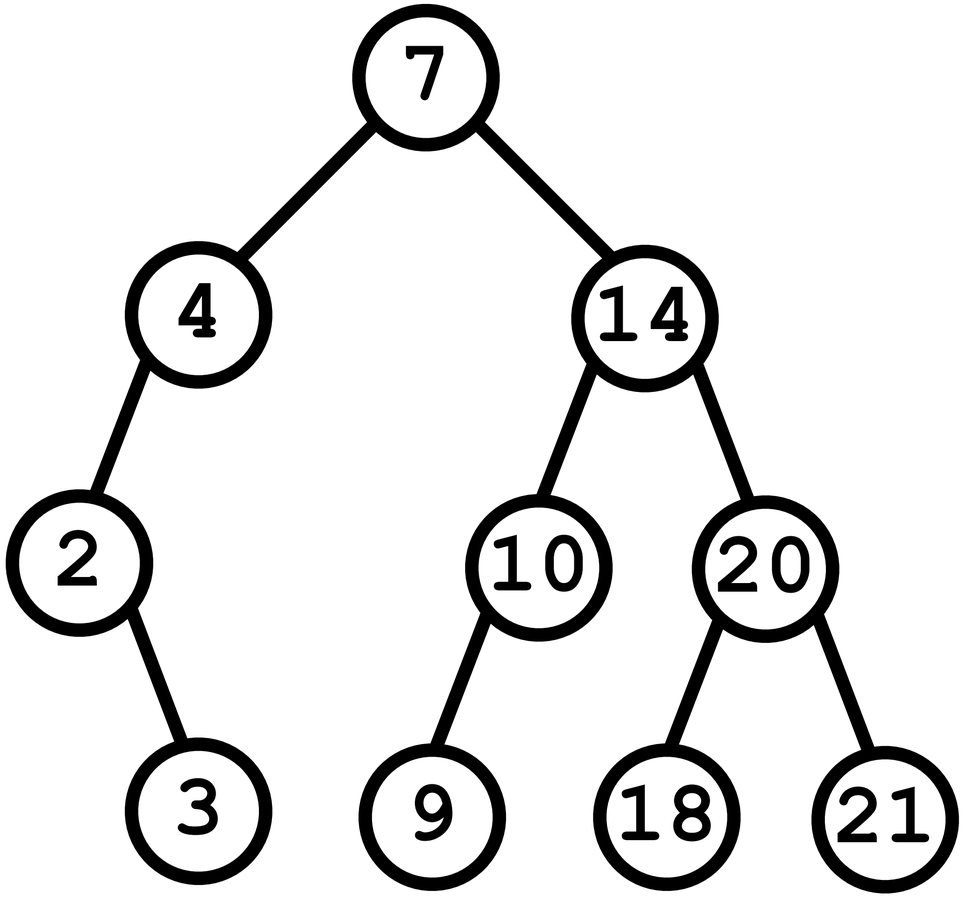
```
struct node{
   int value;
   node *left;
   node *right;
};

int getDepth(node *root, int value, int depth){

}
```

# BST #6

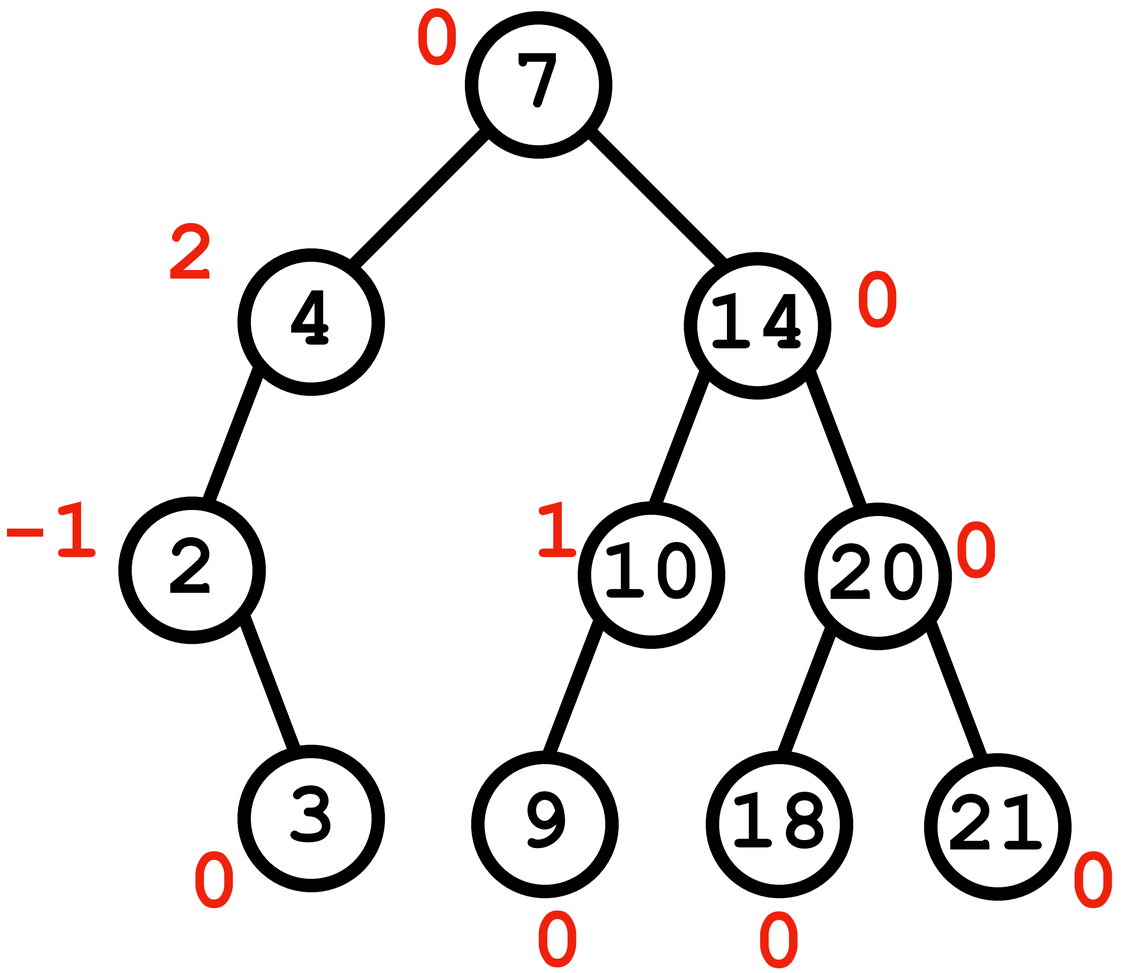
```
int getDepth(node *root, int value, int depth){
  if(root == nullptr){
    return -1;
  }
  else if(root->value == value){
    return depth;
  }
  else if(value < root->value){
    return getDepth(root->left, value, depth + 1);
  }
  else{
    return getDepth(root->right, value, depth + 1);
  }
}
```

# AVL Tree #1

**Give the balance factor of every node in the following BST and indicate which nodes are unbalanced.**



# AVL Tree #1



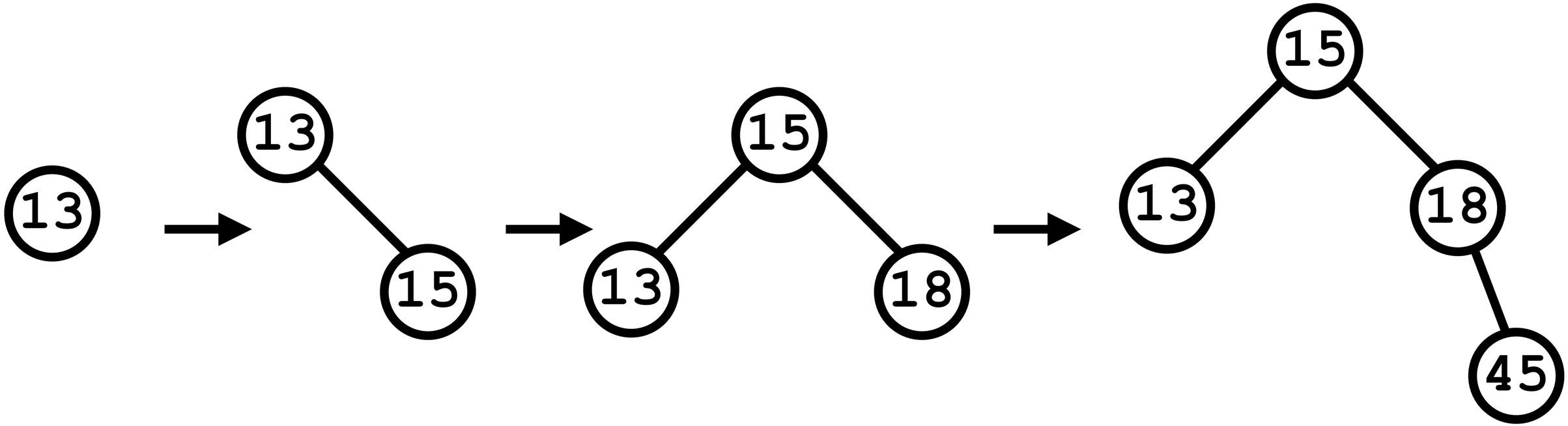

**node 4 is unbalanced**

# AVL Tree #2

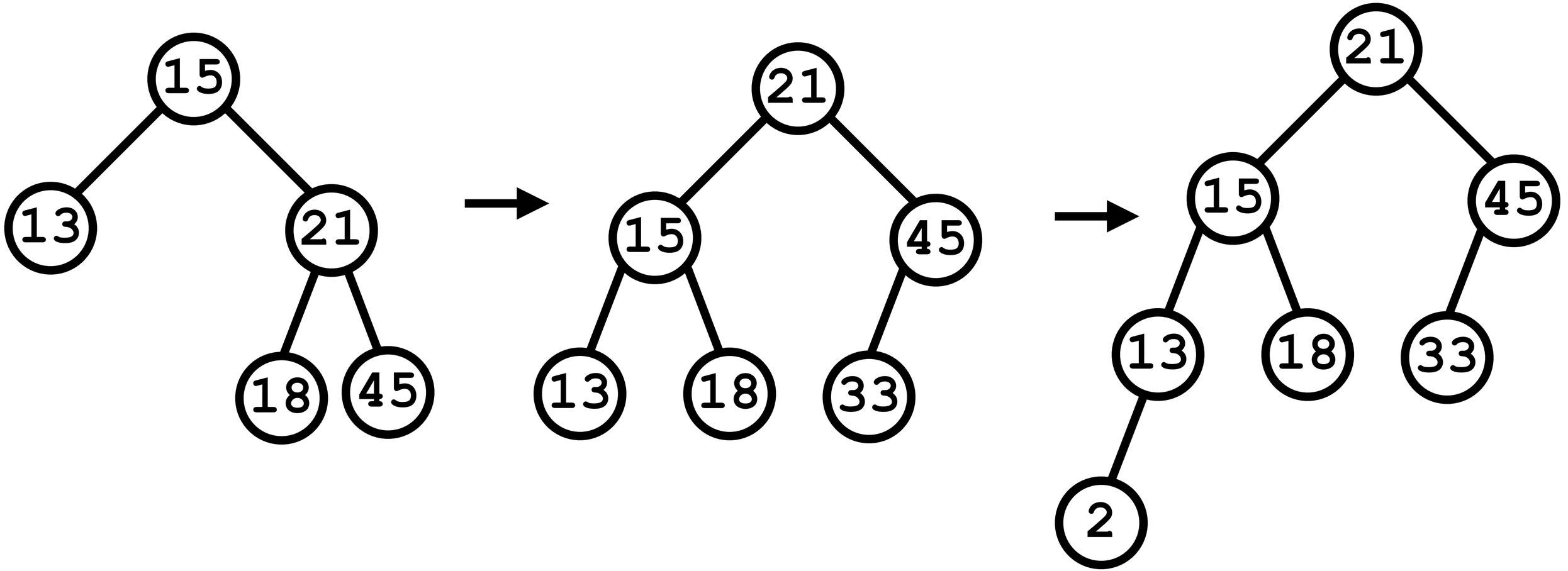
**Insert the following values into an AVL Tree in the order in which they appear.**

**13, 15, 18, 45, 21, 33, 2, 1**

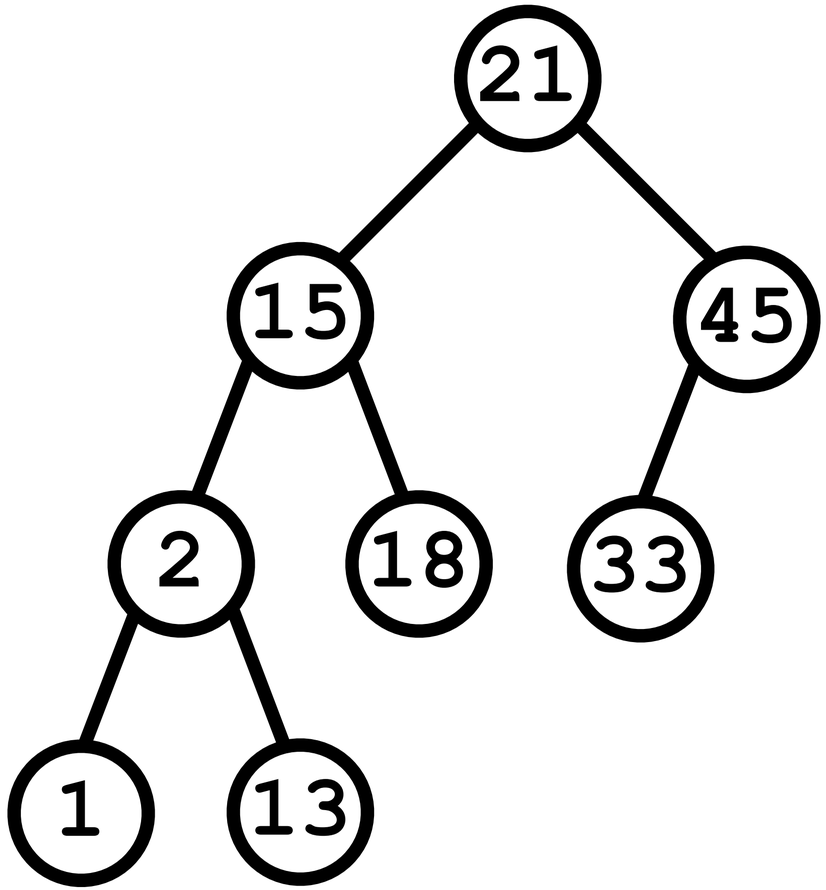
# AVL Tree #2



# AVL Tree #2

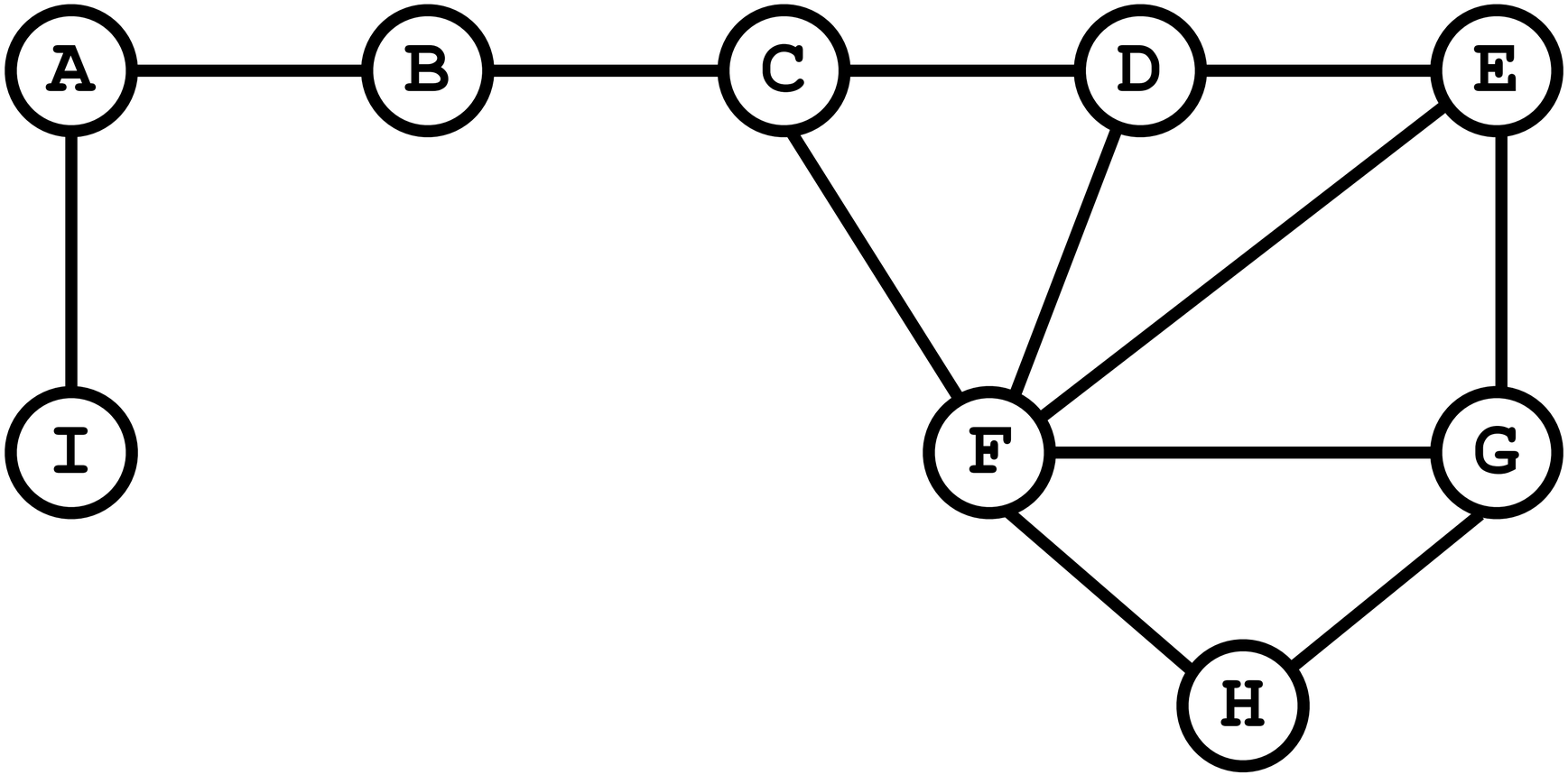


# AVL Tree #2

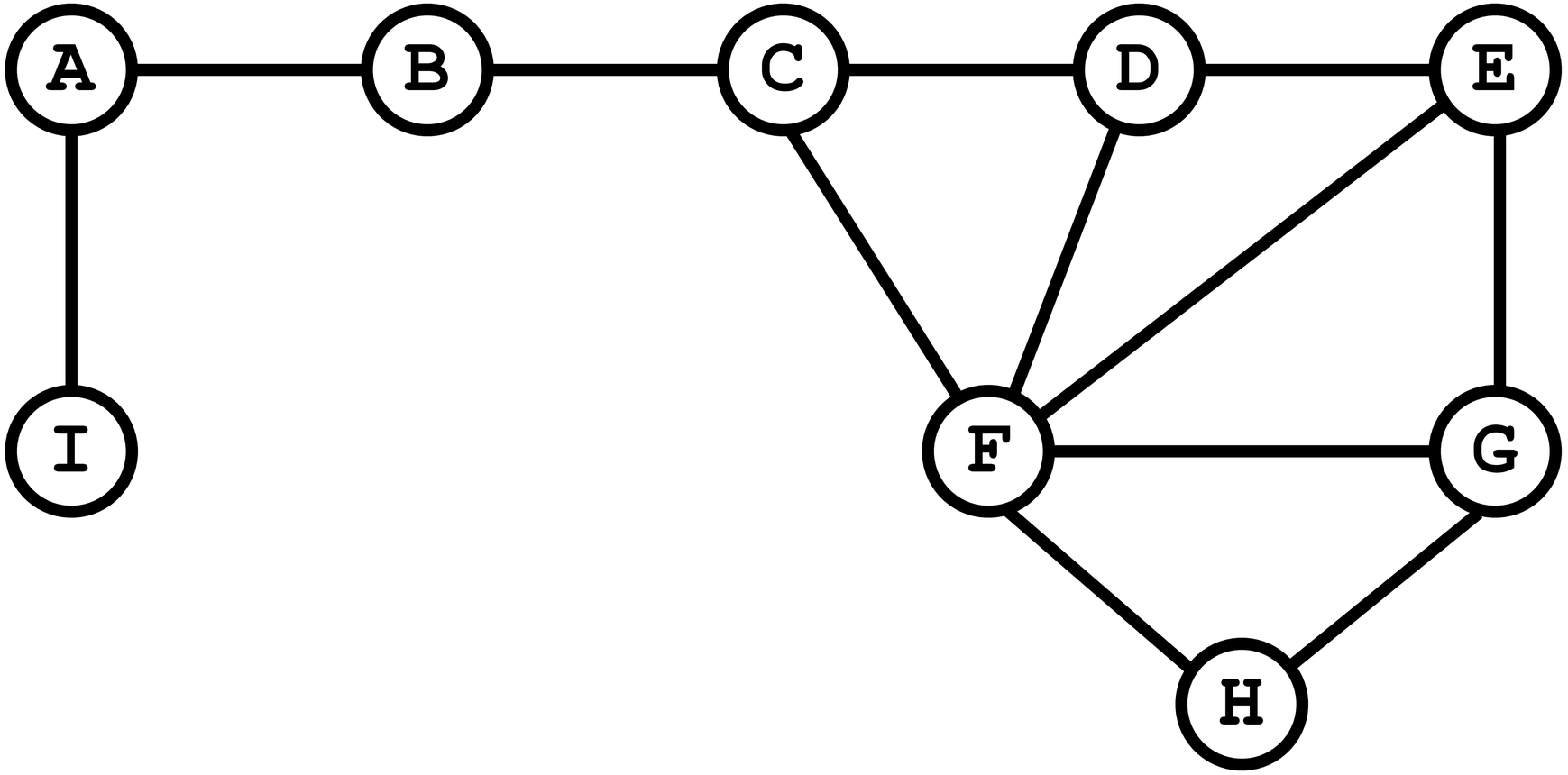


# Graphs #1

**Perform Depth First Traversal and Breadth First Traversal starting from vertex A on the graph below.**



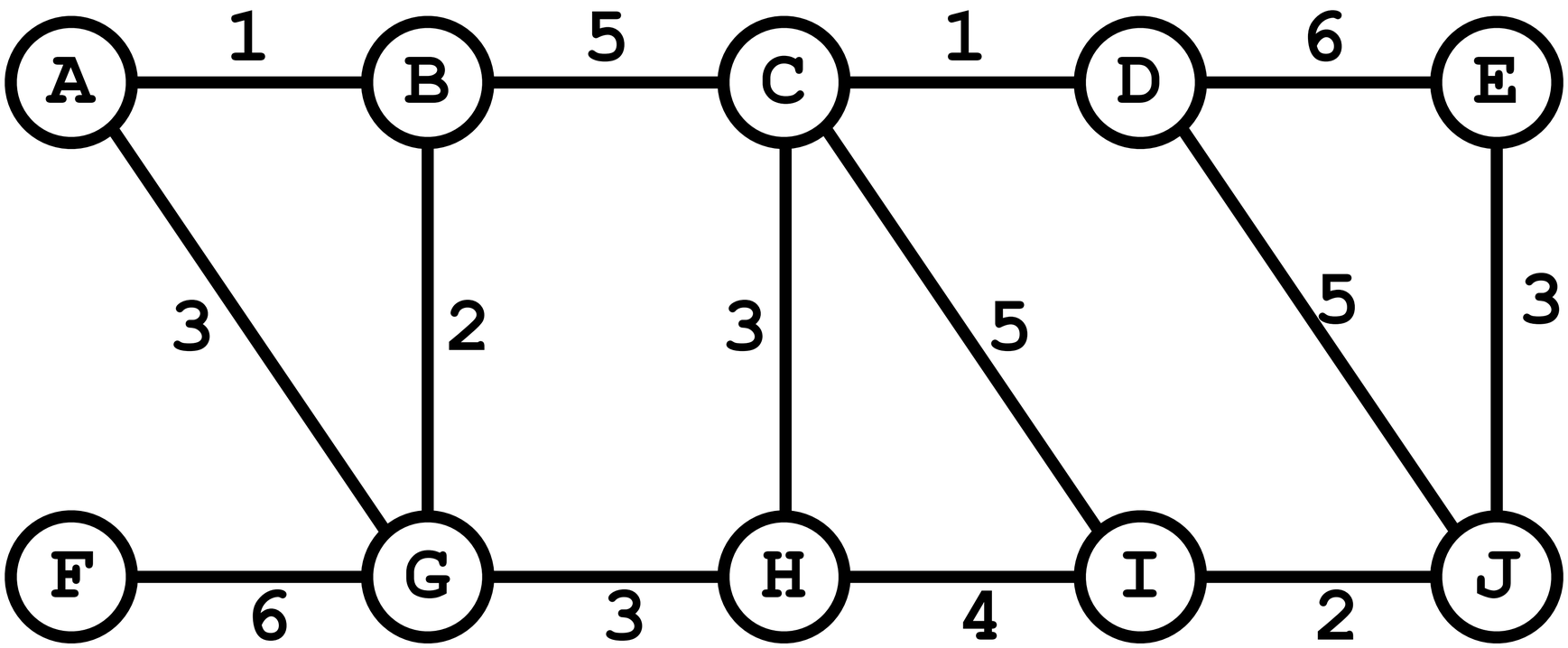
# Graphs #1



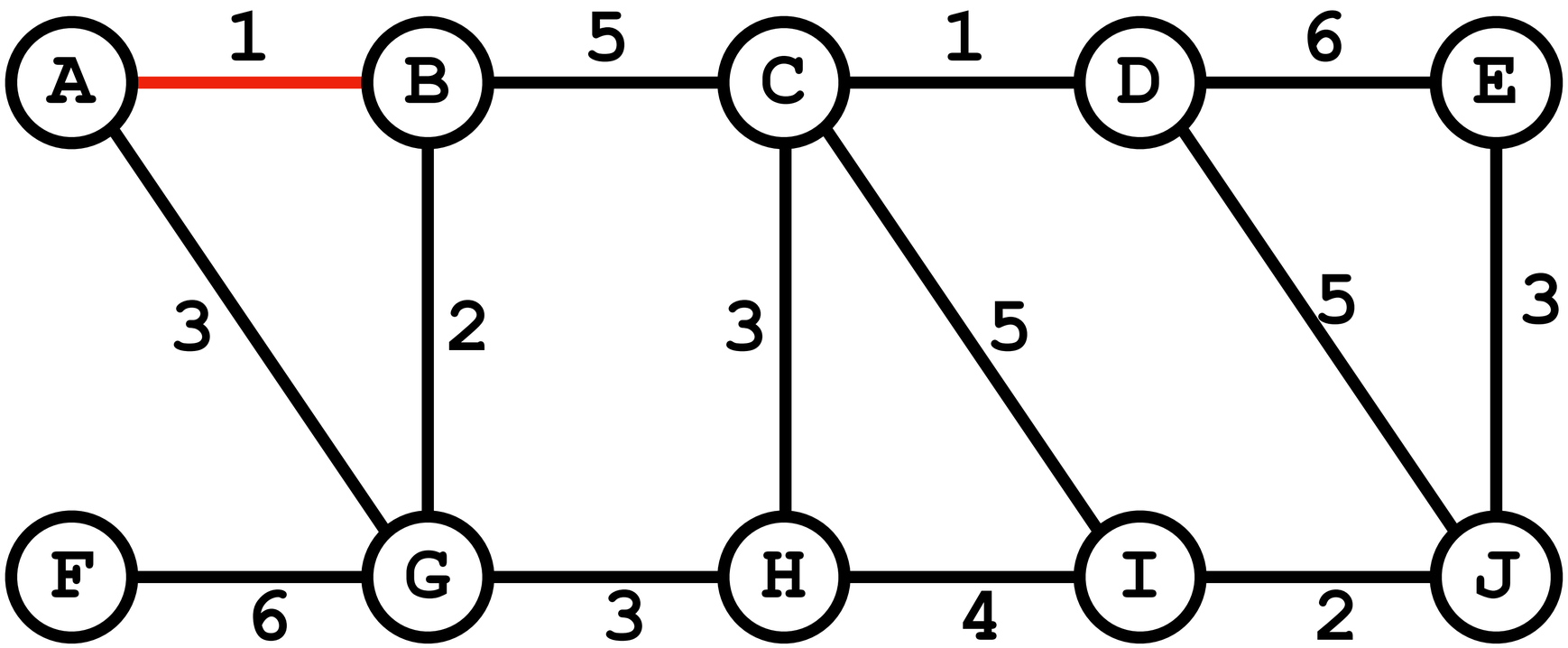

**Depth First Traversal: A, B, C, D, E, F, G, H, I**
**Breadth First Traversal: A, B, I, C, D, F, E, G, H**

# Graphs #2

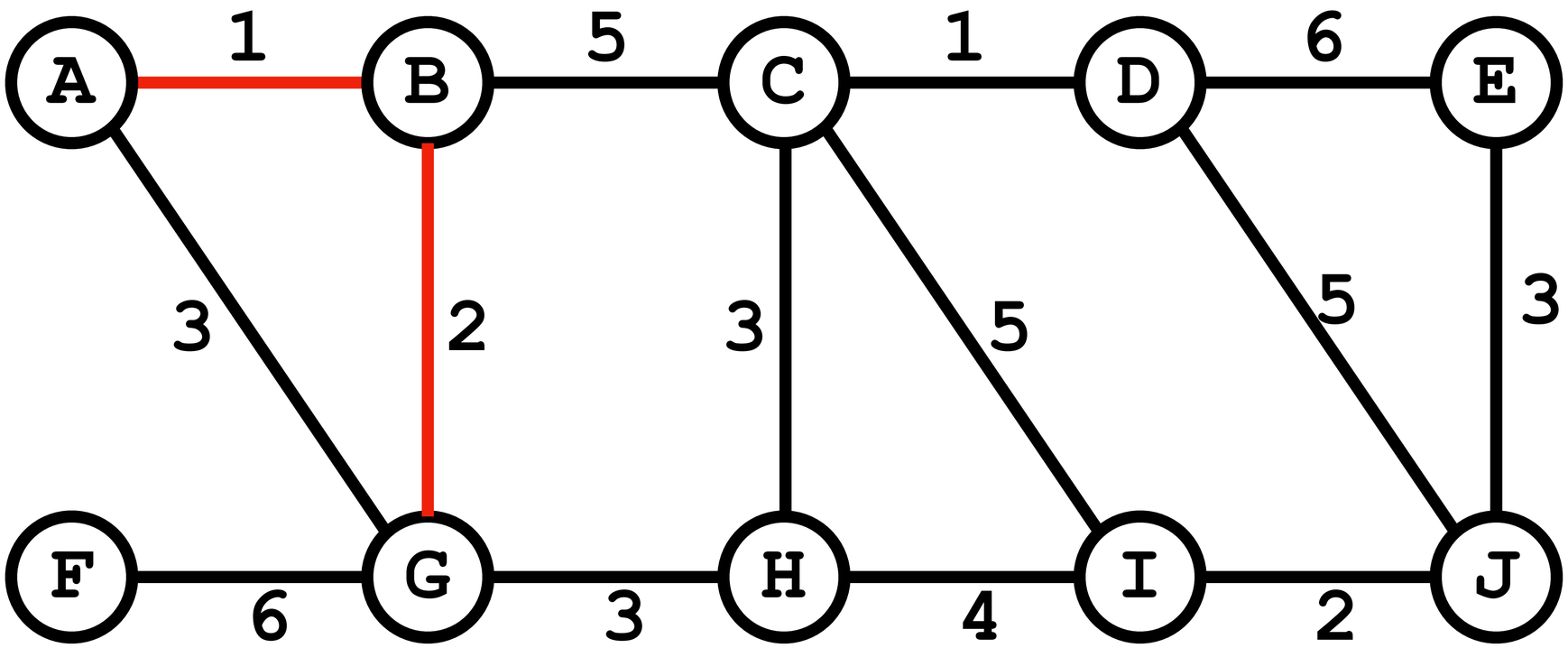
**Draw the MST using Prim's algorithm starting from vertex A.**



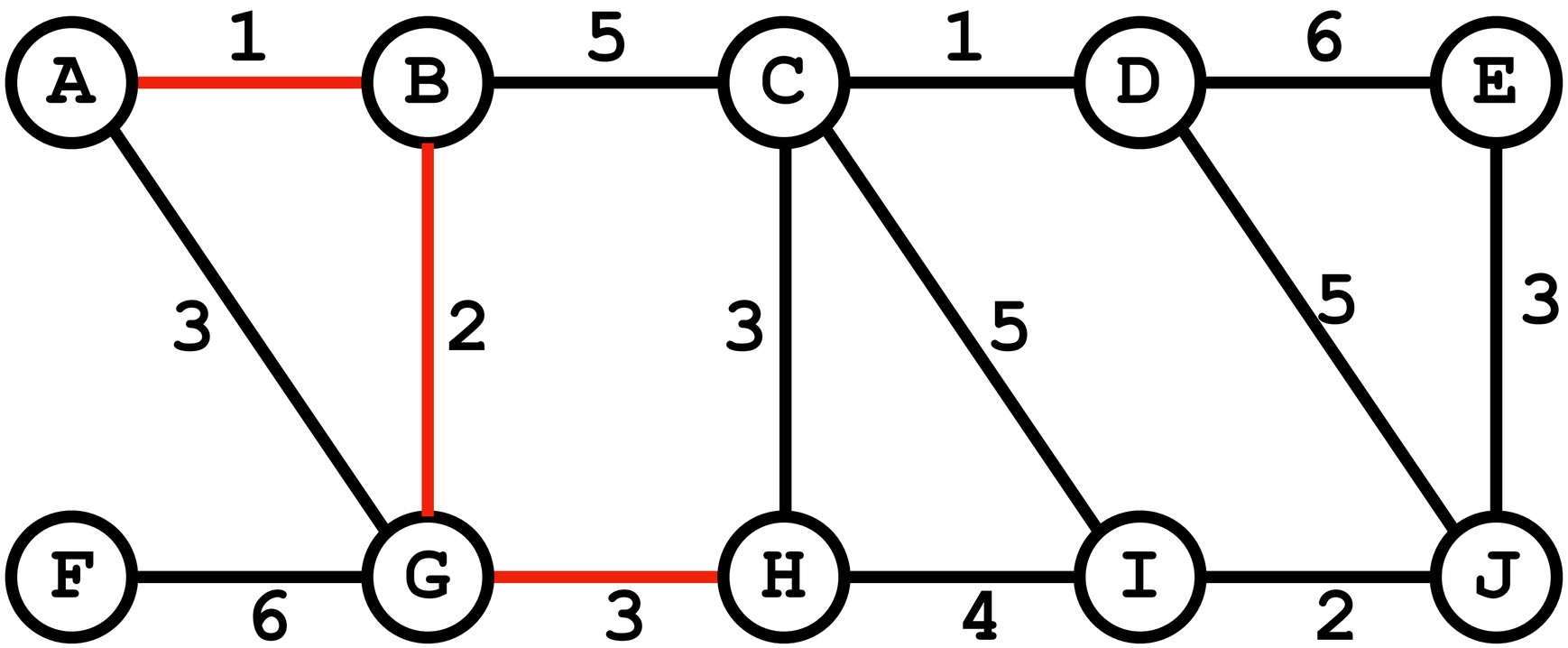
# Graphs #2



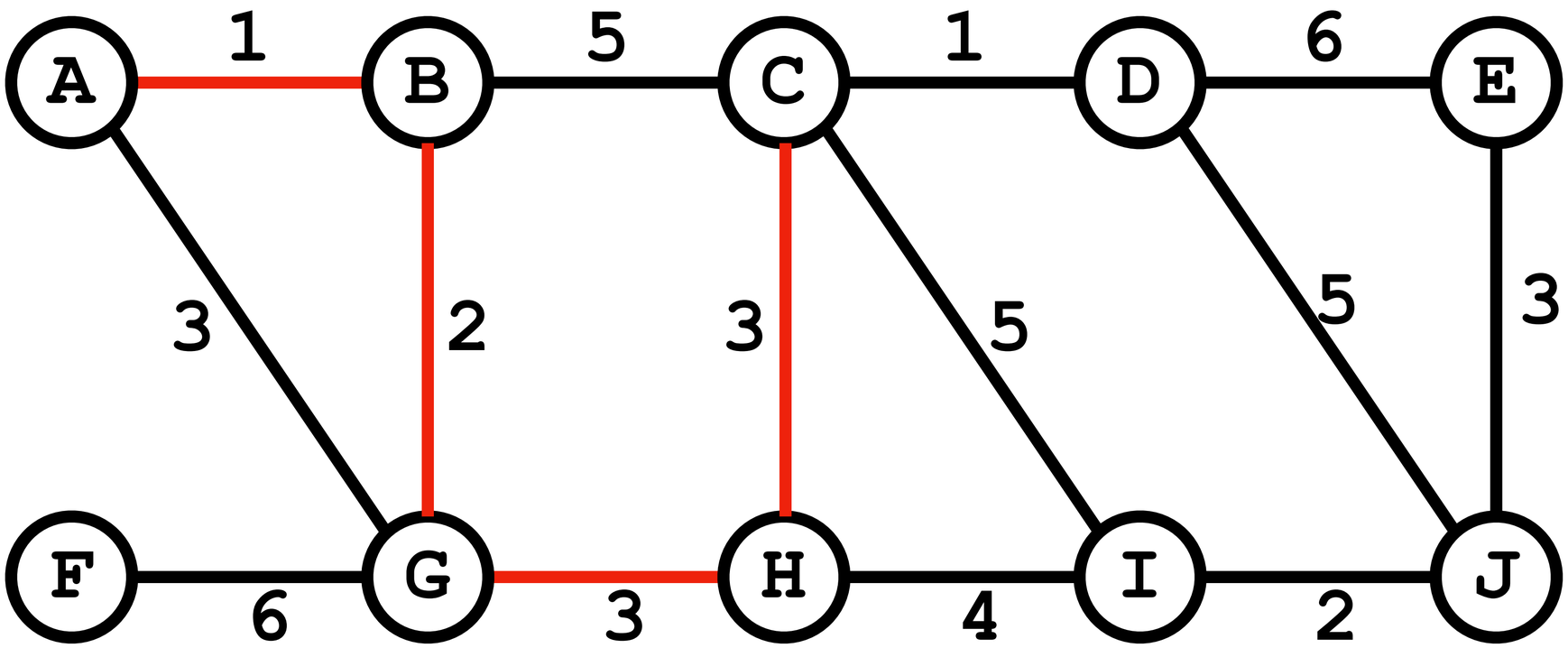
# Graphs #2



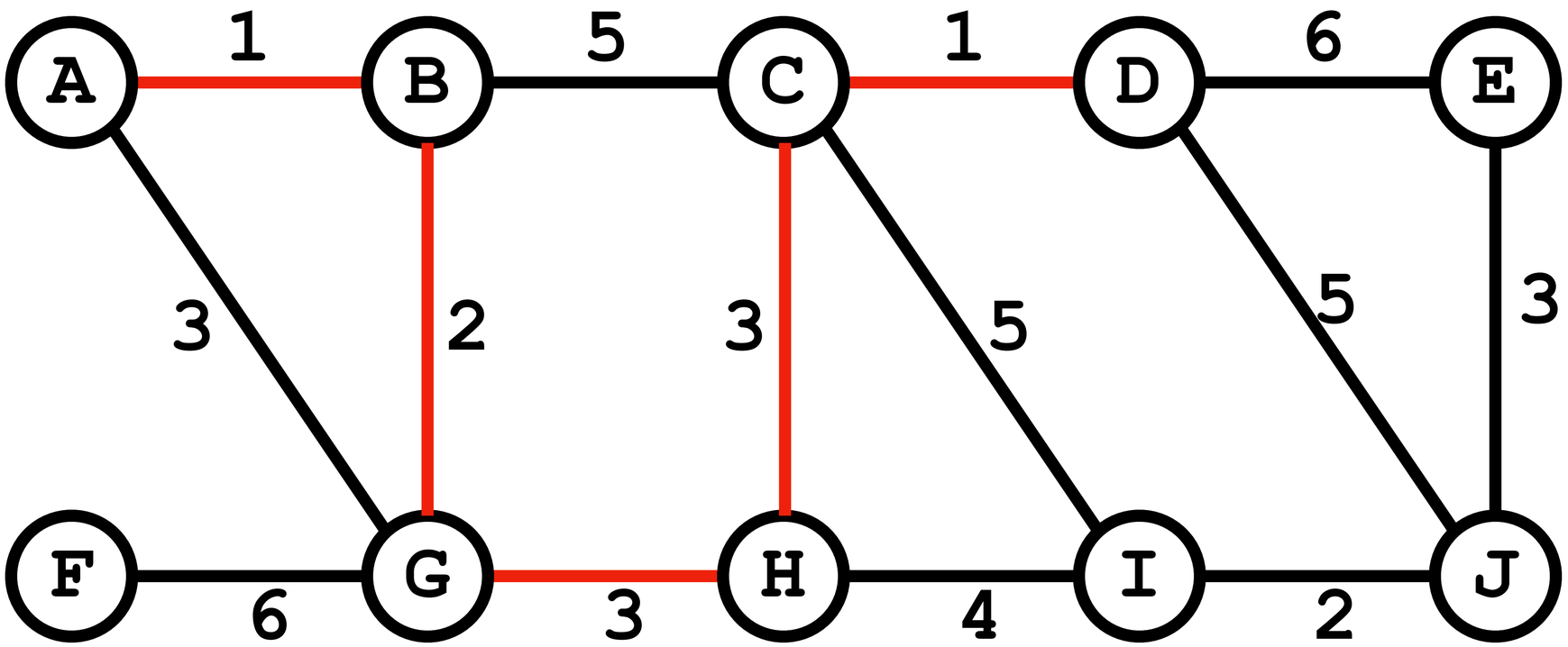
# Graphs #2



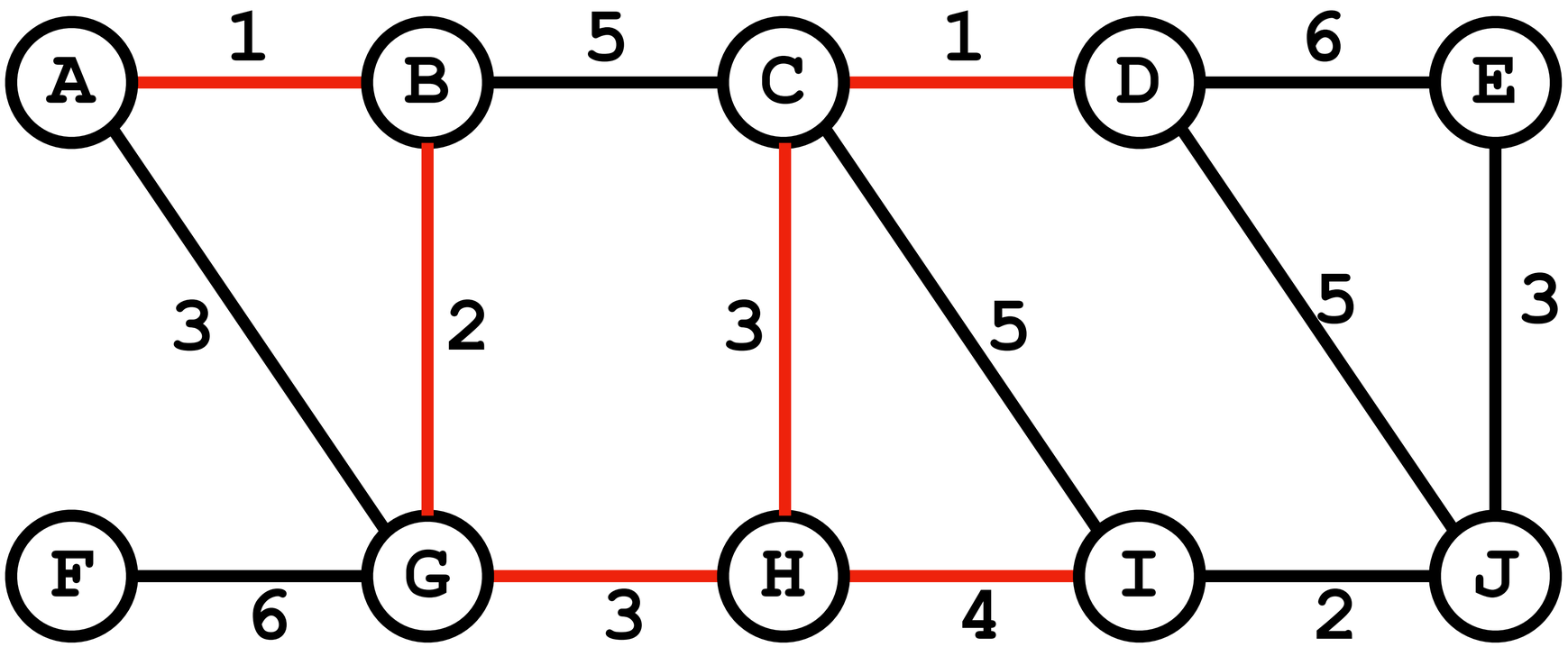
# Graphs #2



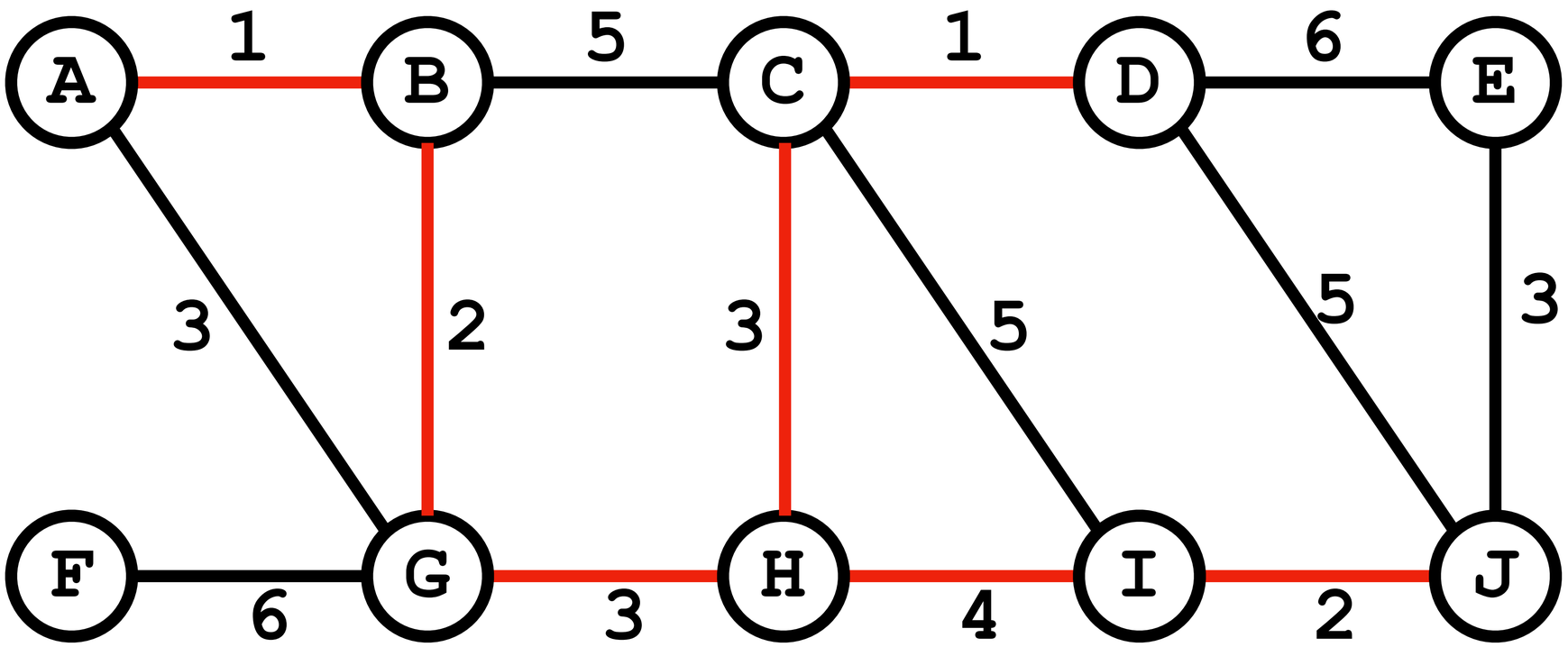
# Graphs #2



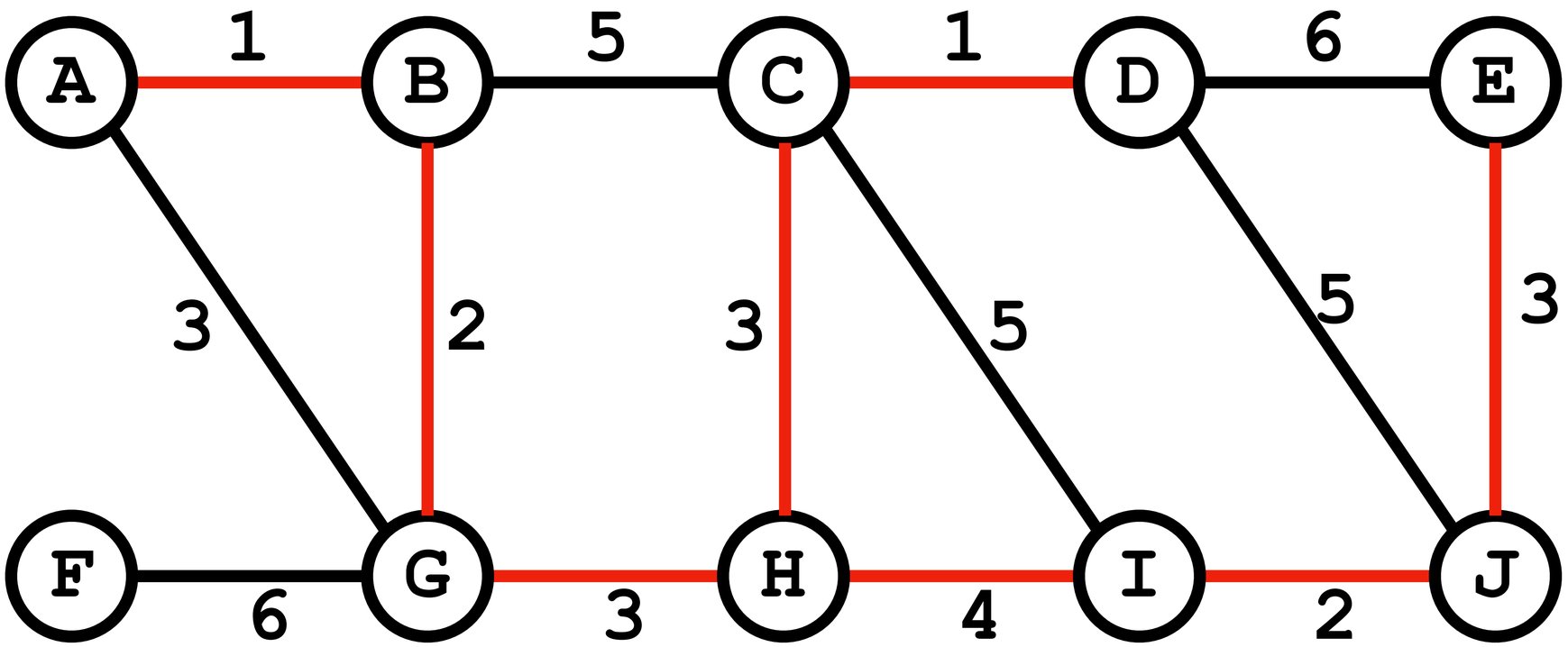
# Graphs #2



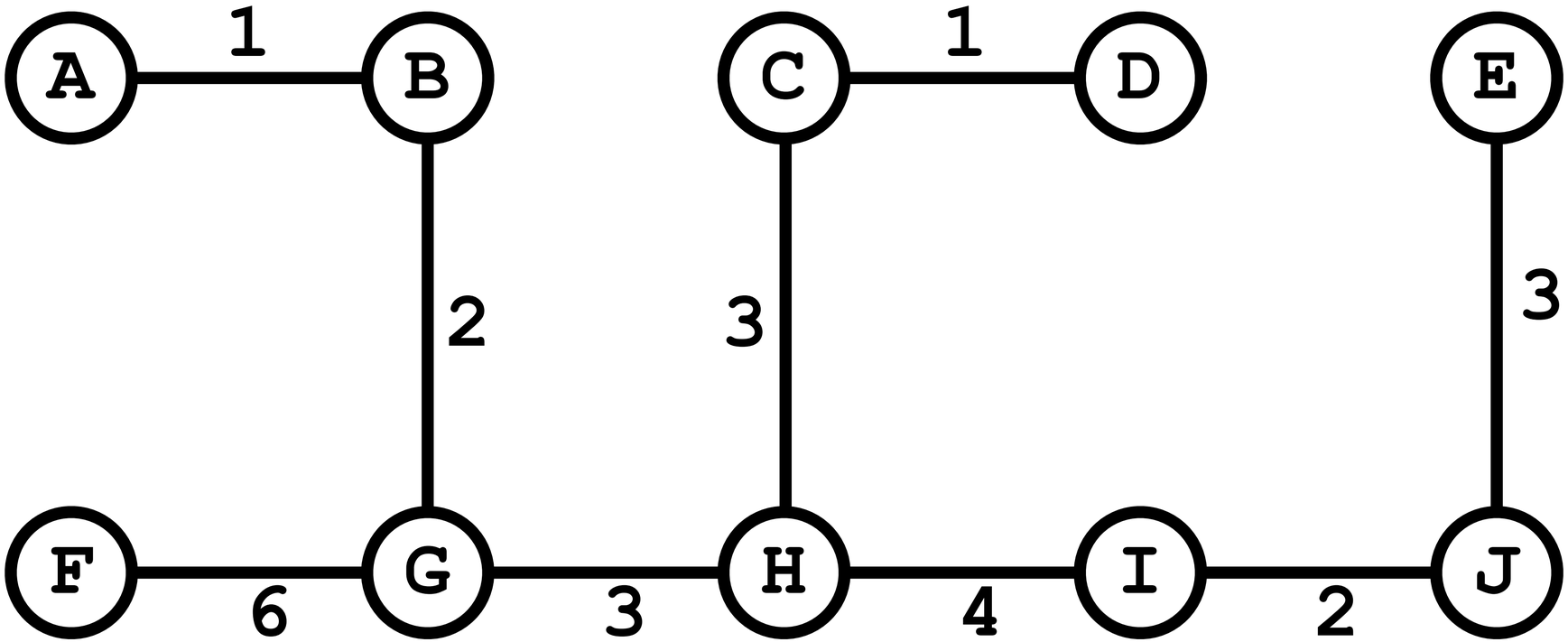
# Graphs #2



# Graphs #2

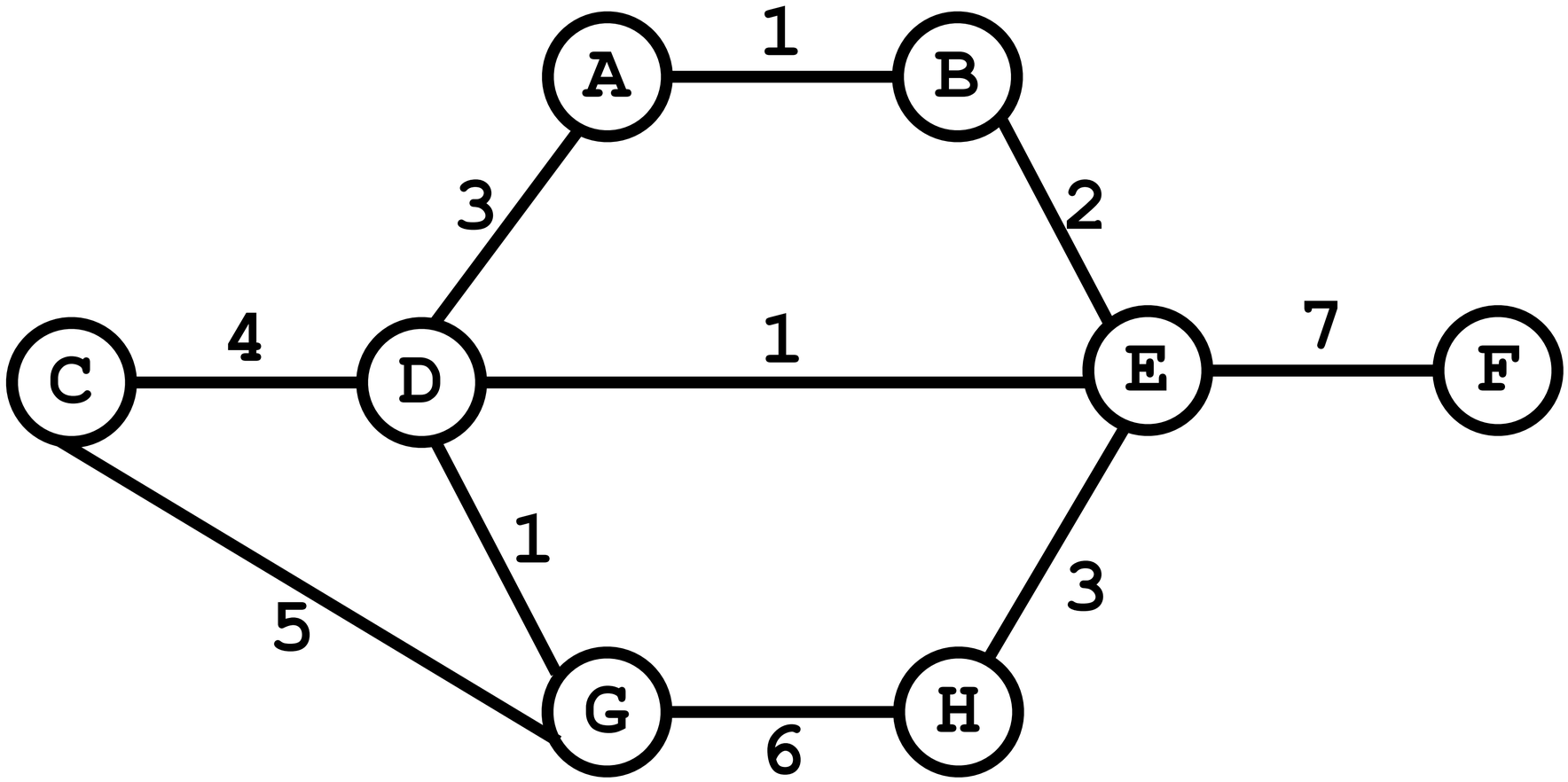


# Graphs #2

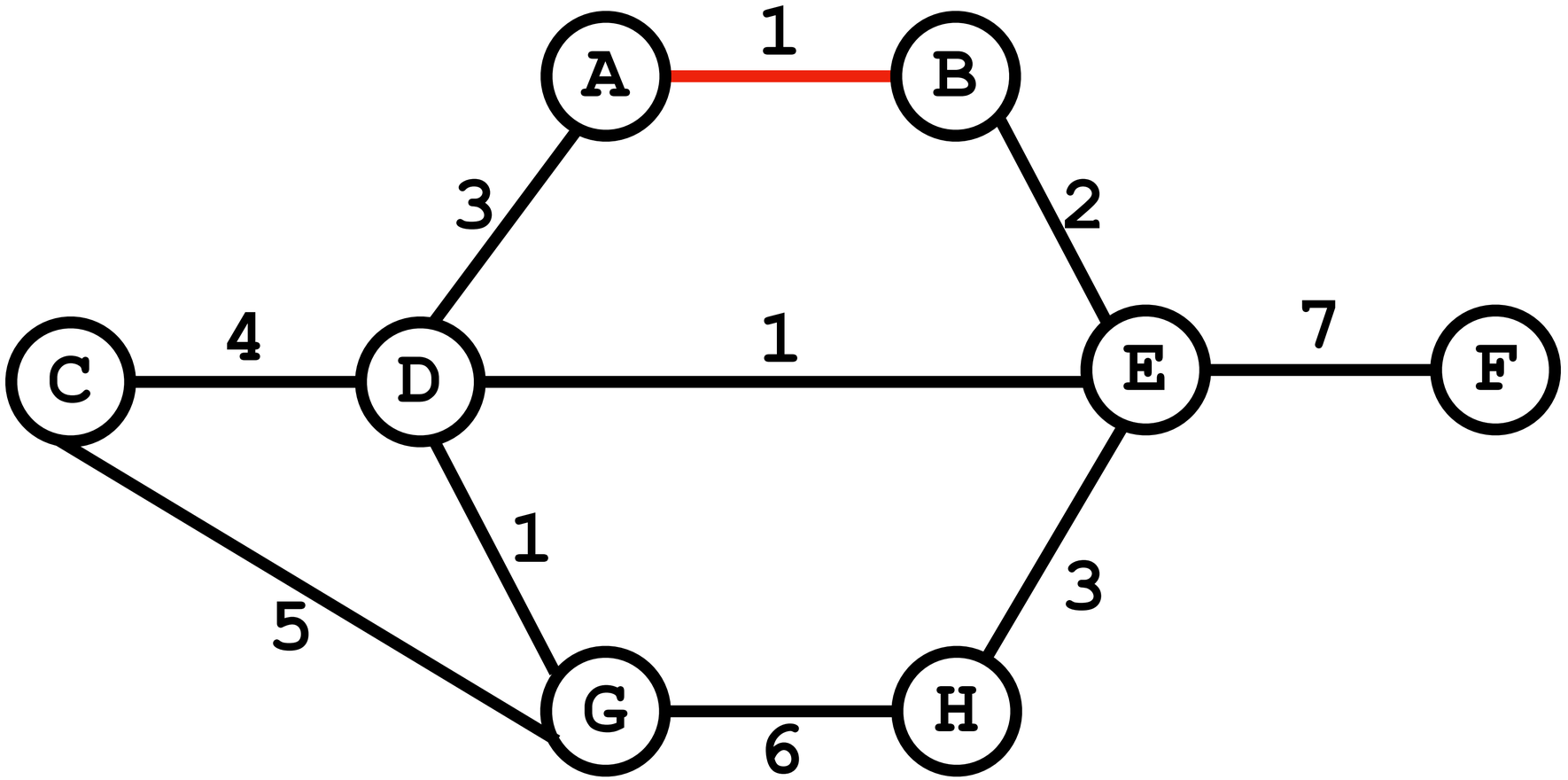


# Graphs #3

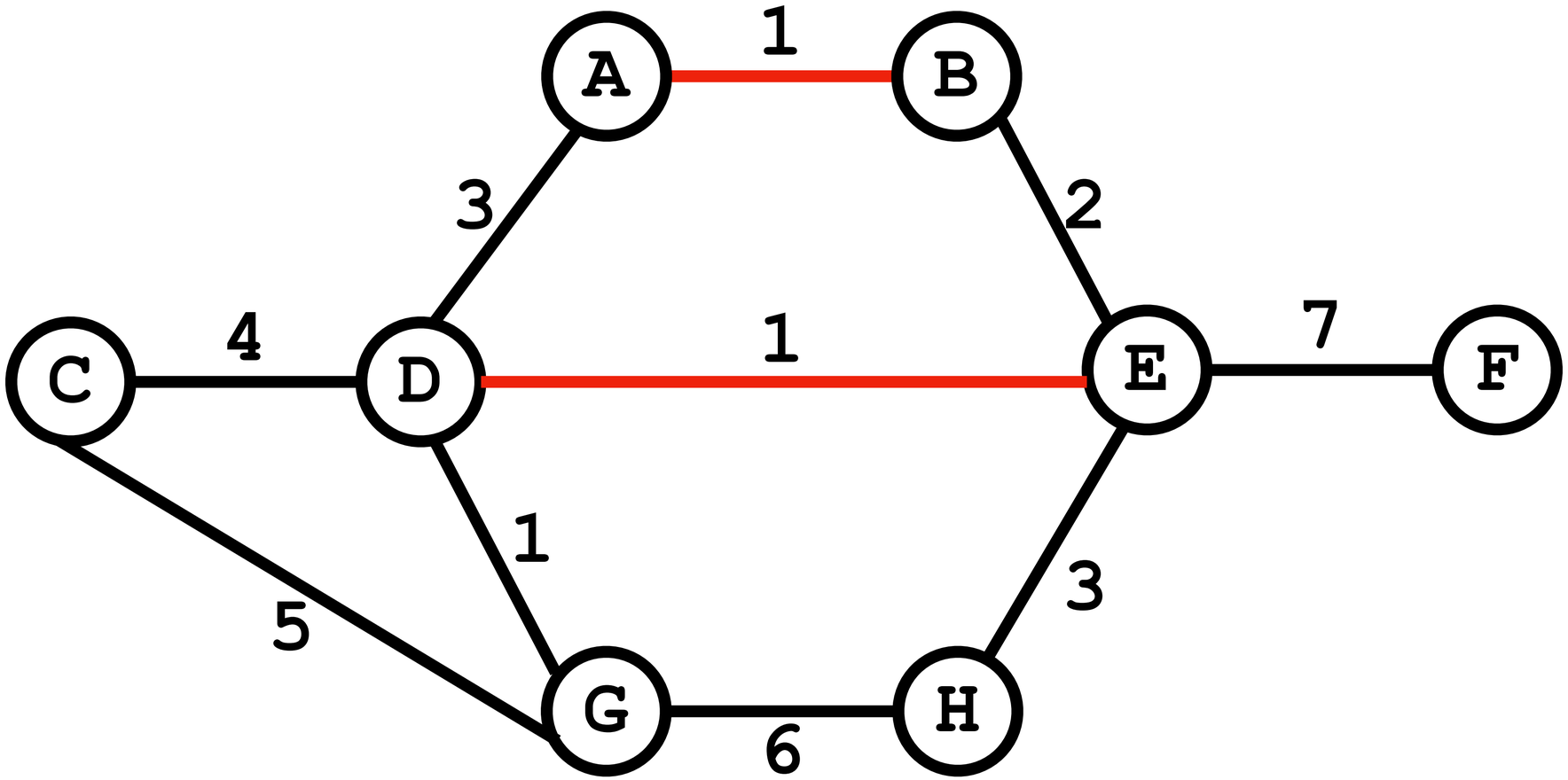
**Draw the MST using Kruskal's algorithm.**



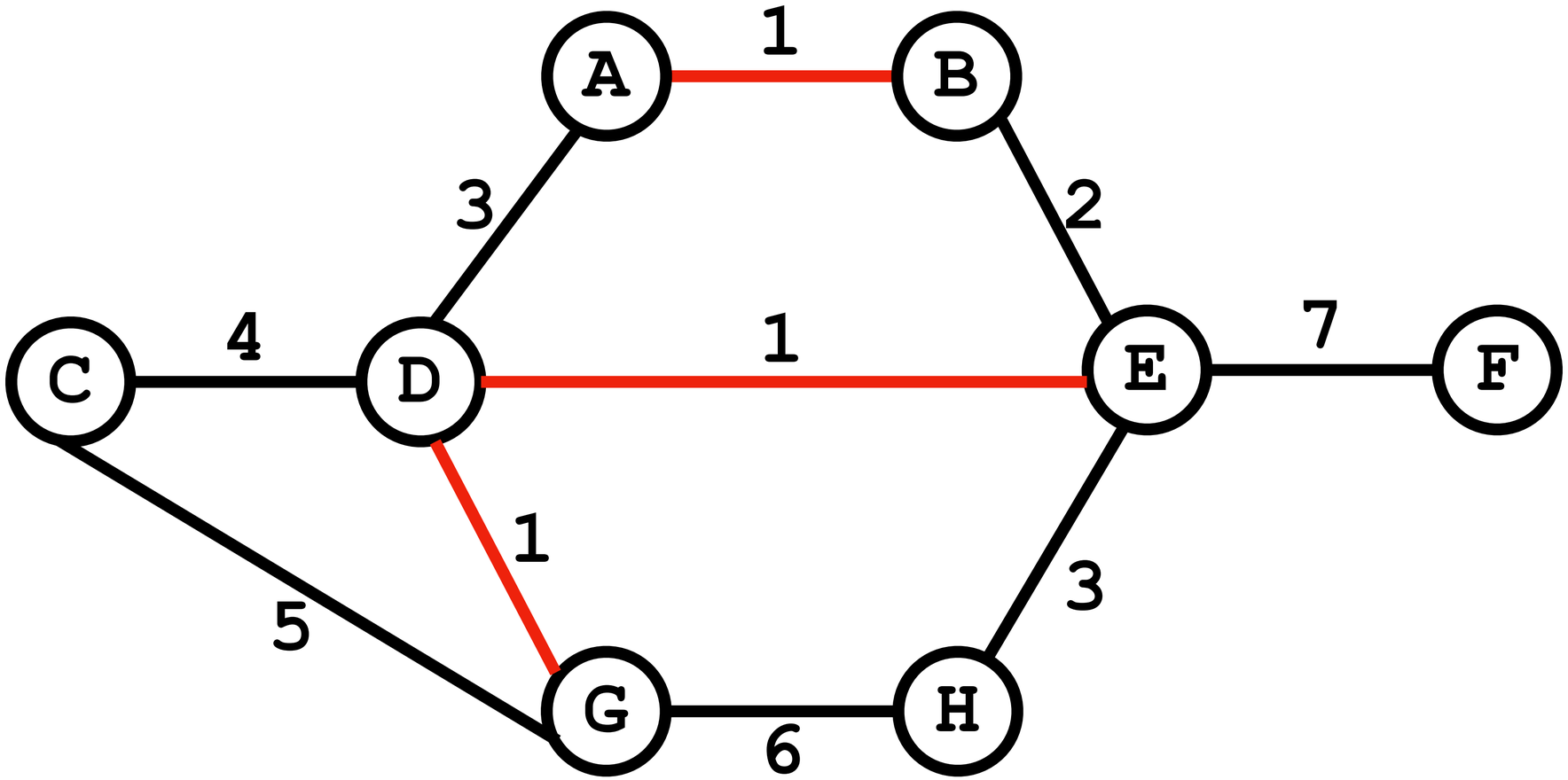
# Graphs #3



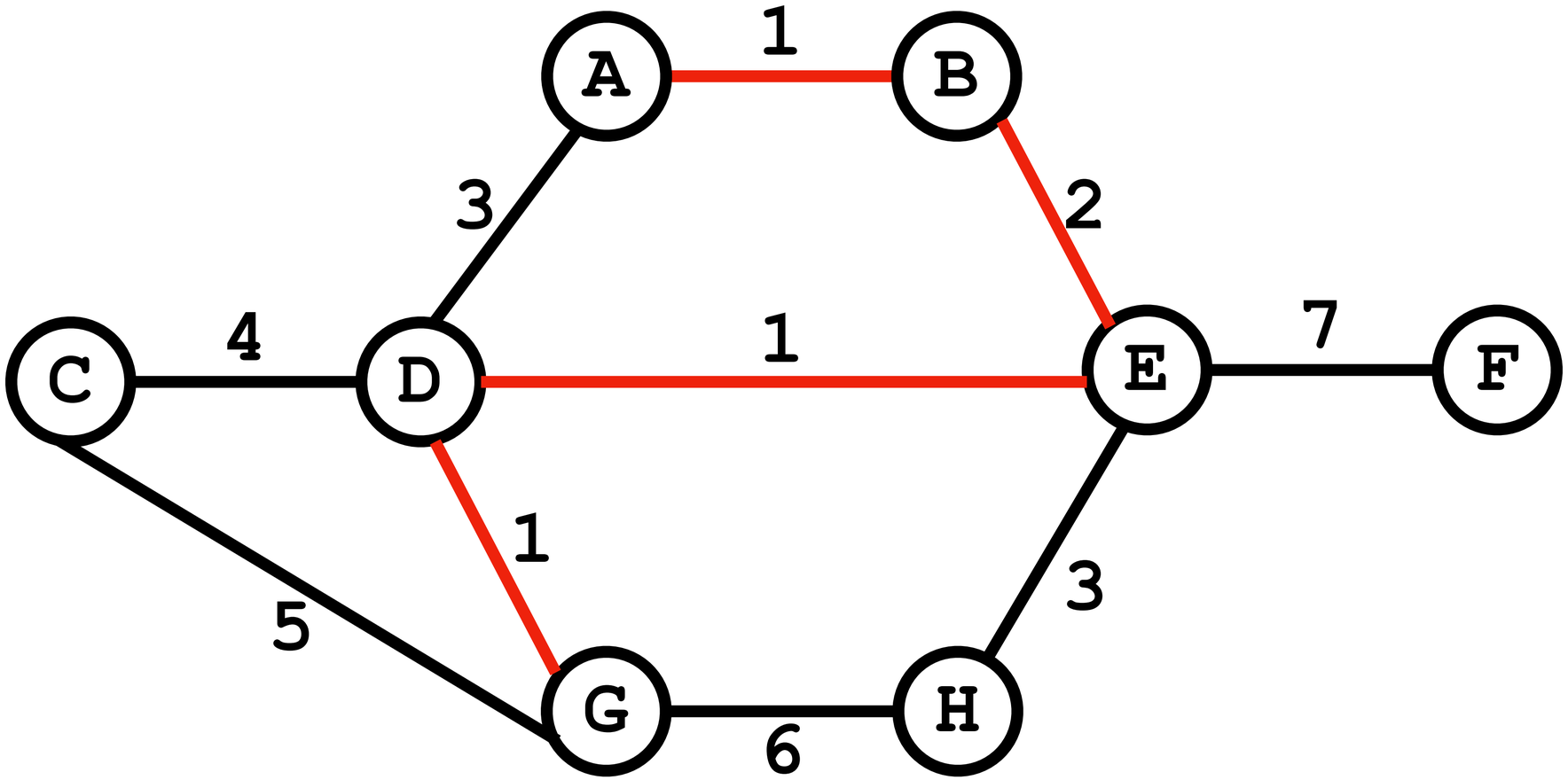
# Graphs #3



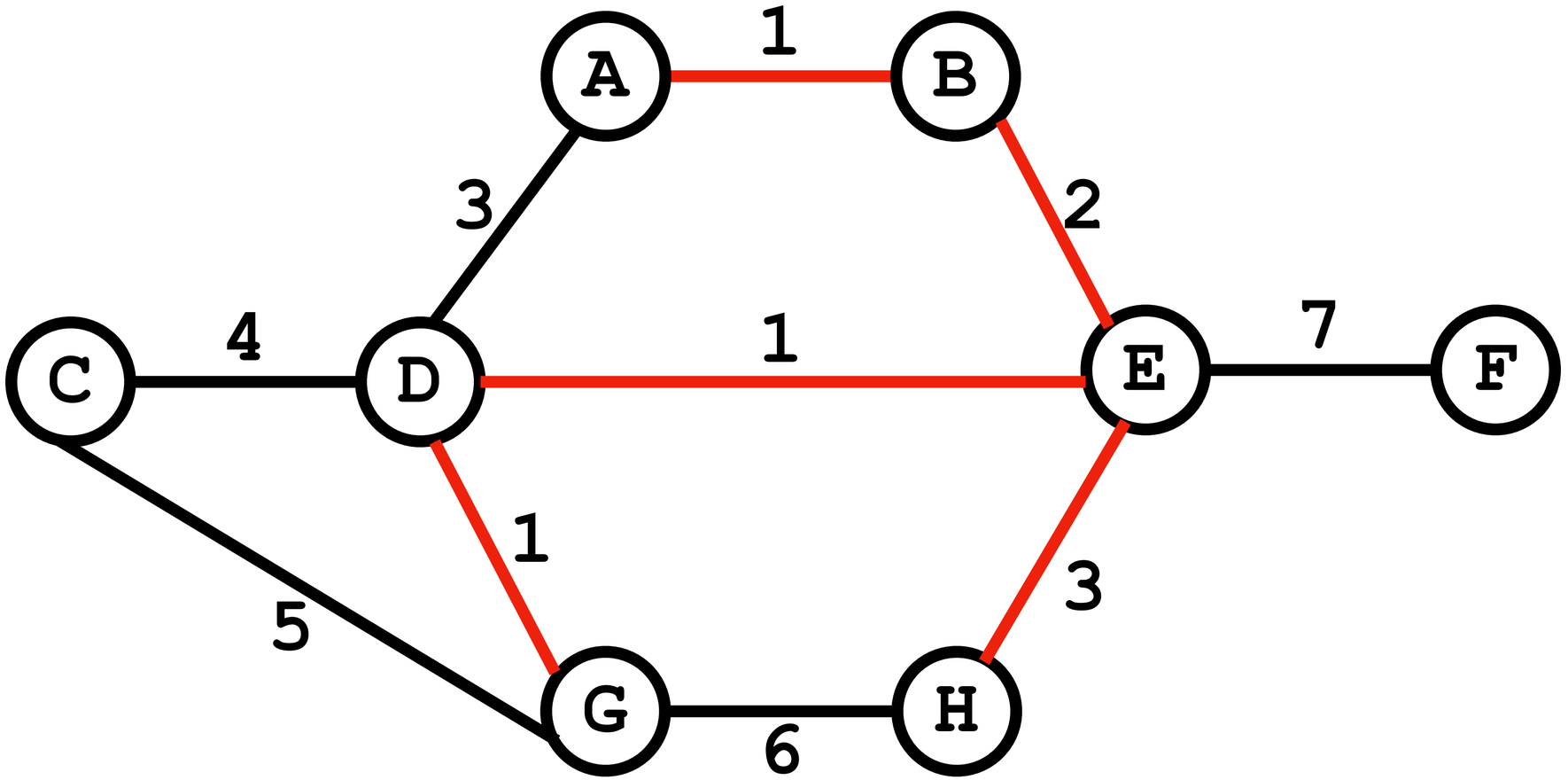
# Graphs #3



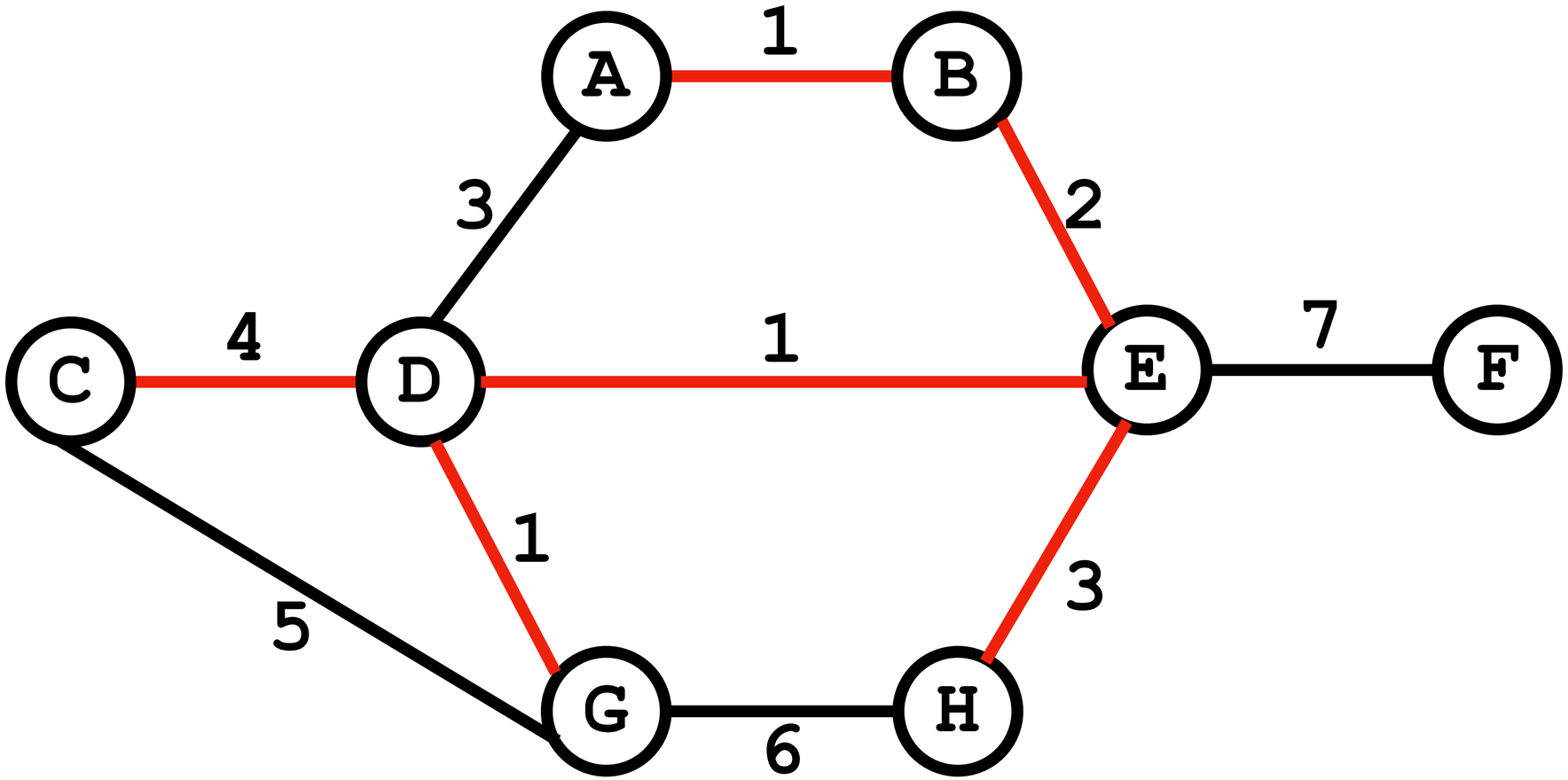
# Graphs #3



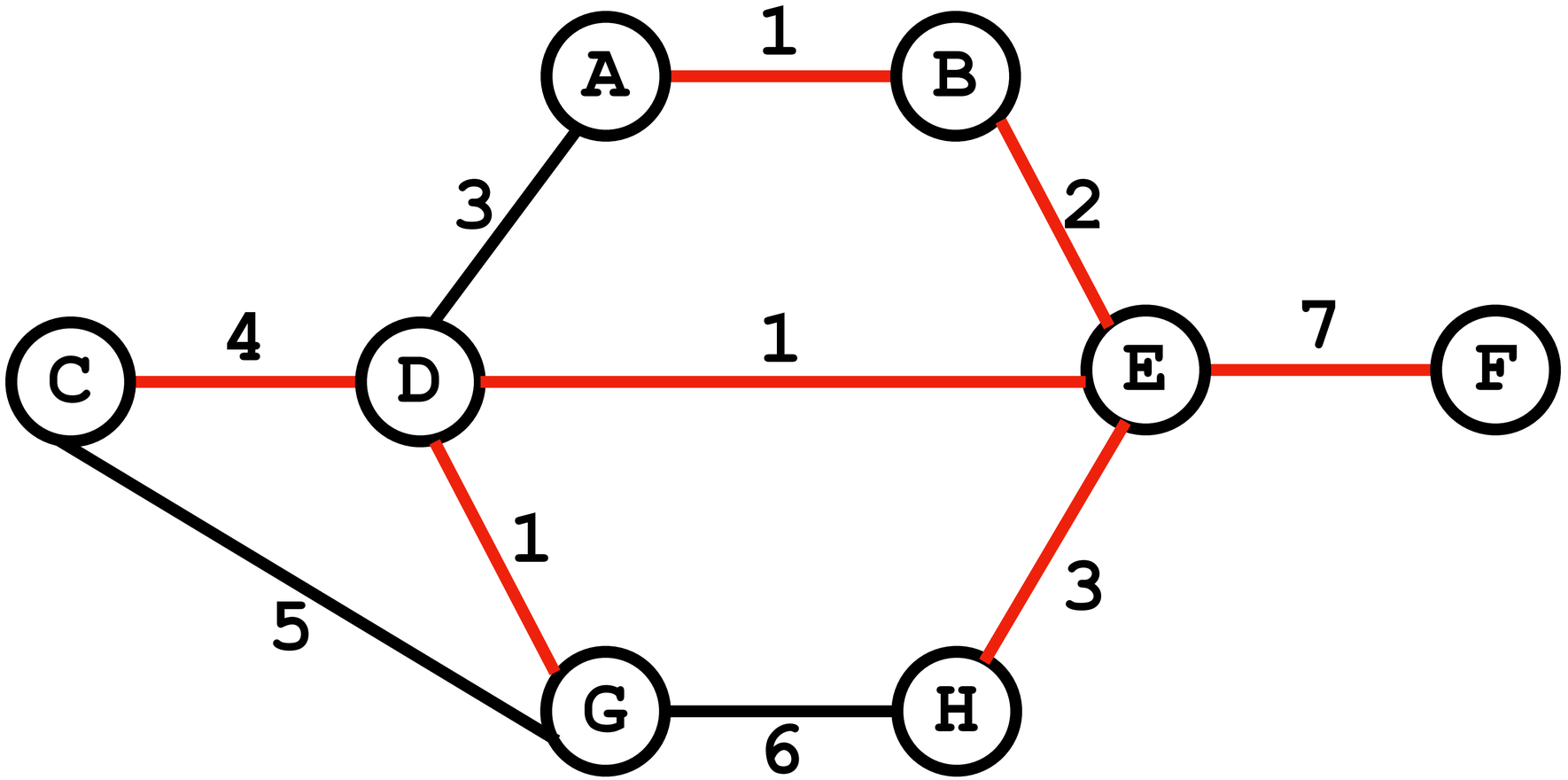
# Graphs #3



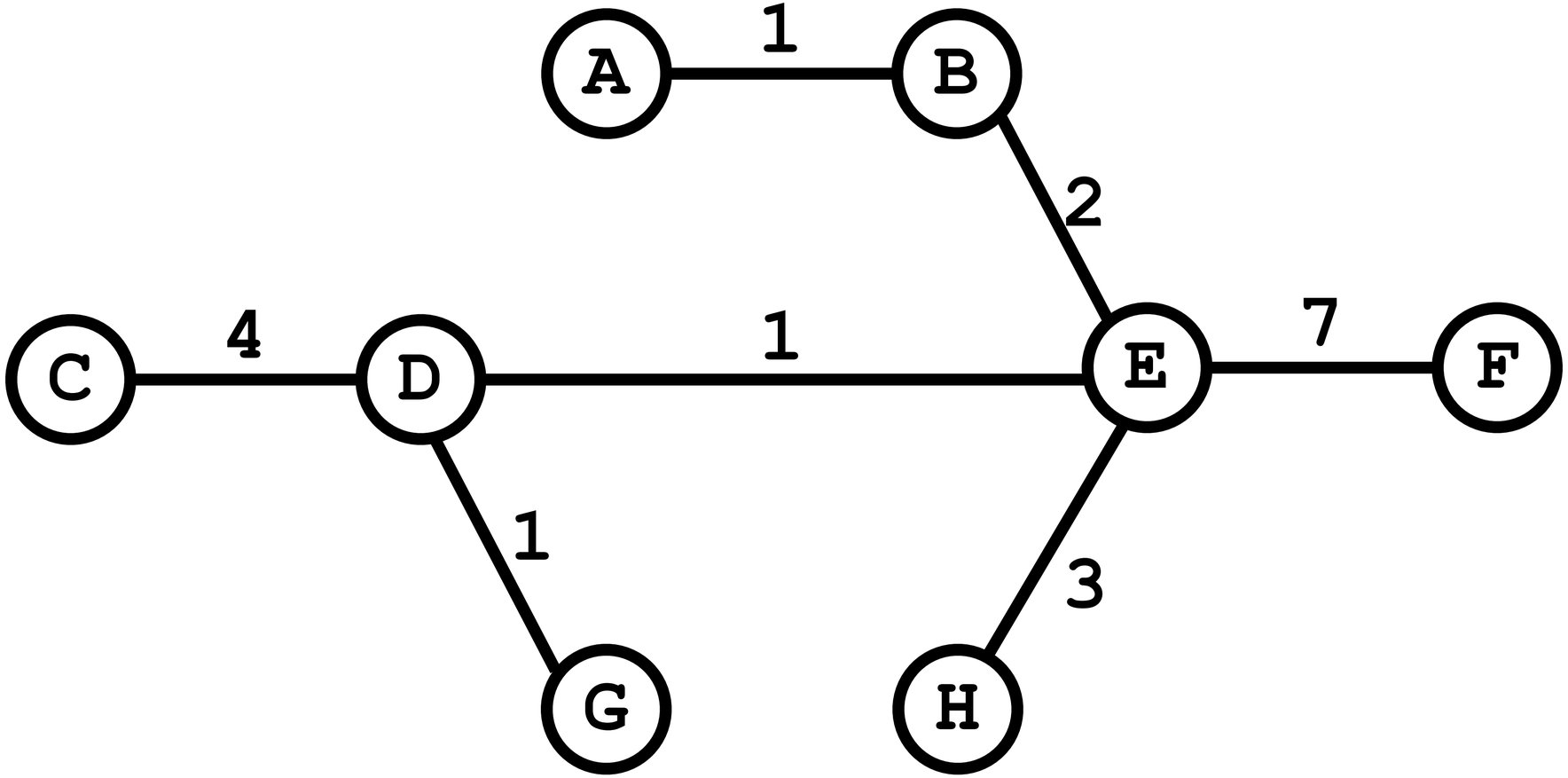
# Graphs #3



# Graphs #3

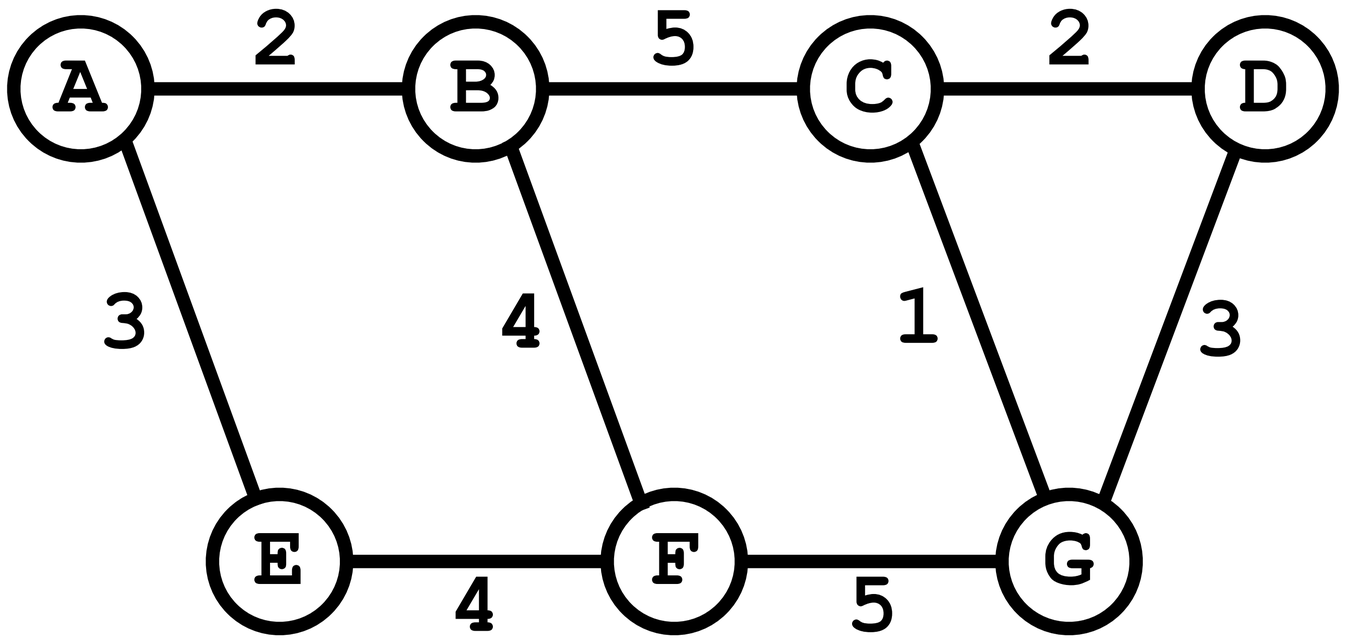


# Graphs #3

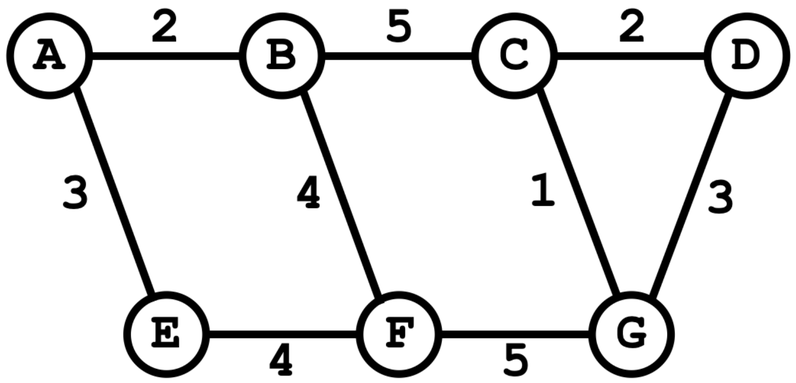


# Graphs #4

**Given the graph below, draw the shortest path tree from vertex A using Dijkstras.**



# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
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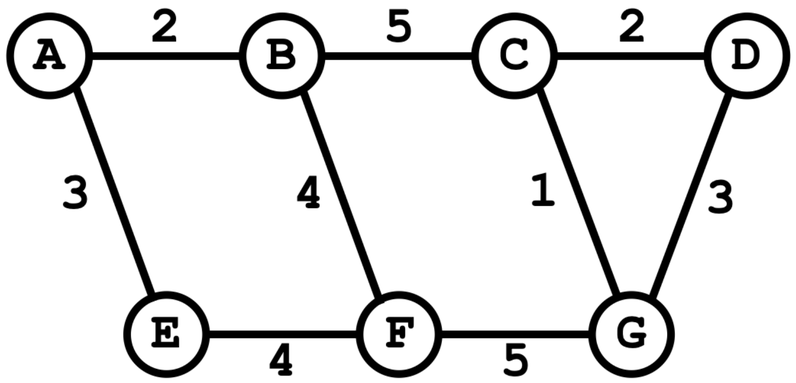
# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
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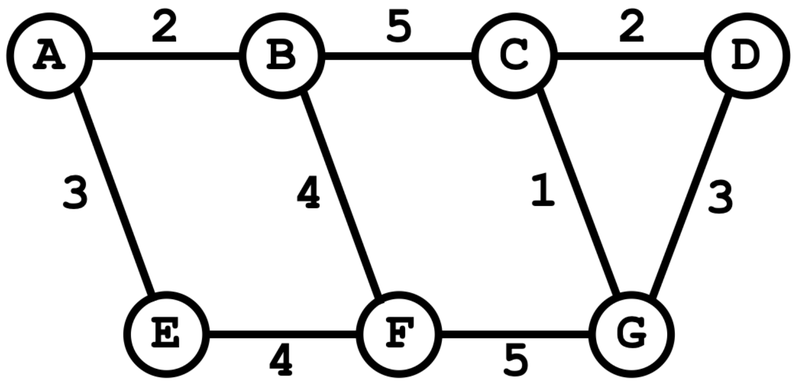
# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | | | | | |
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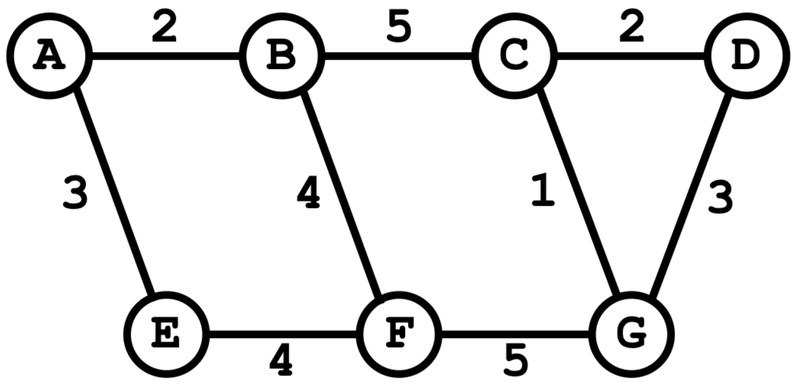
# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | 7 | ∞ | 3 | 6 | ∞ |
| | | | | | | |
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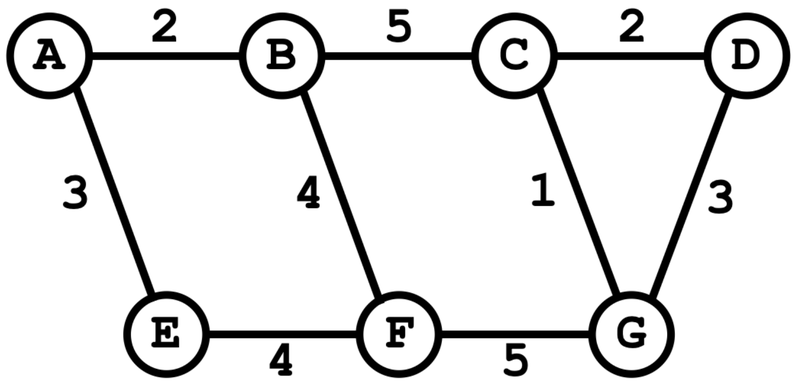
| | | | | | | |

# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | 7 | ∞ | 3 | 6 | ∞ |
| | | 7 | ∞ | | 6 | ∞ |
| | | | | | | |
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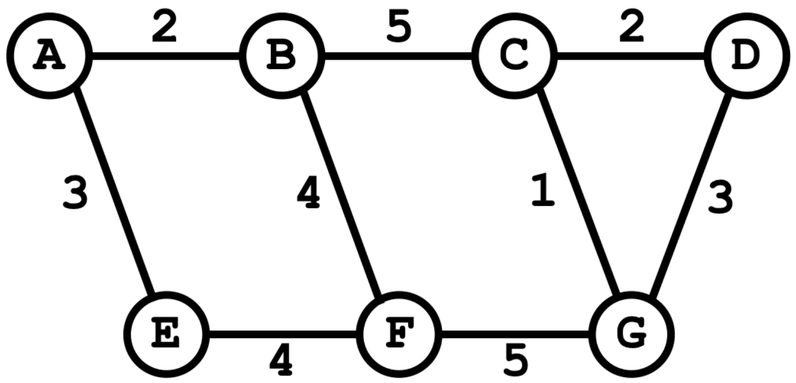
# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | 7 | ∞ | 3 | 6 | ∞ |
| | | 7 | ∞ | | 6 | ∞ |
| | | 7 | ∞ | | | 11 |
| | | | | | | |
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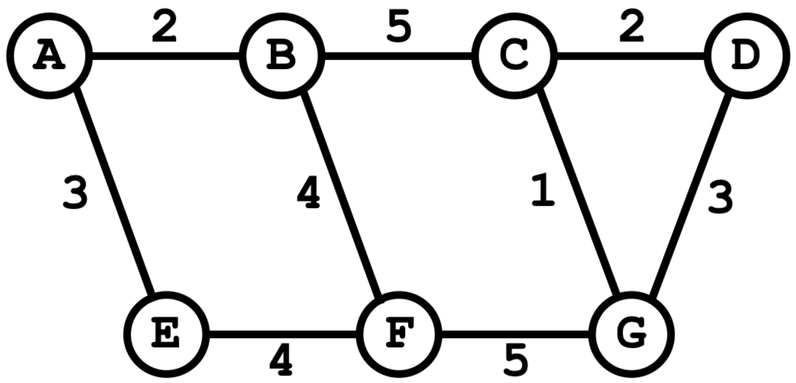
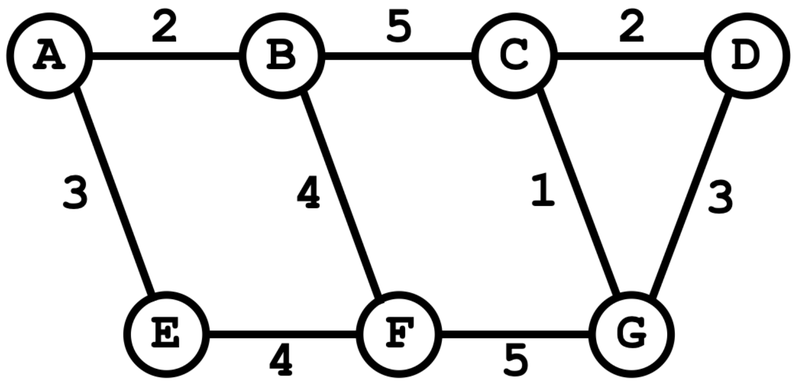
# Graphs #4



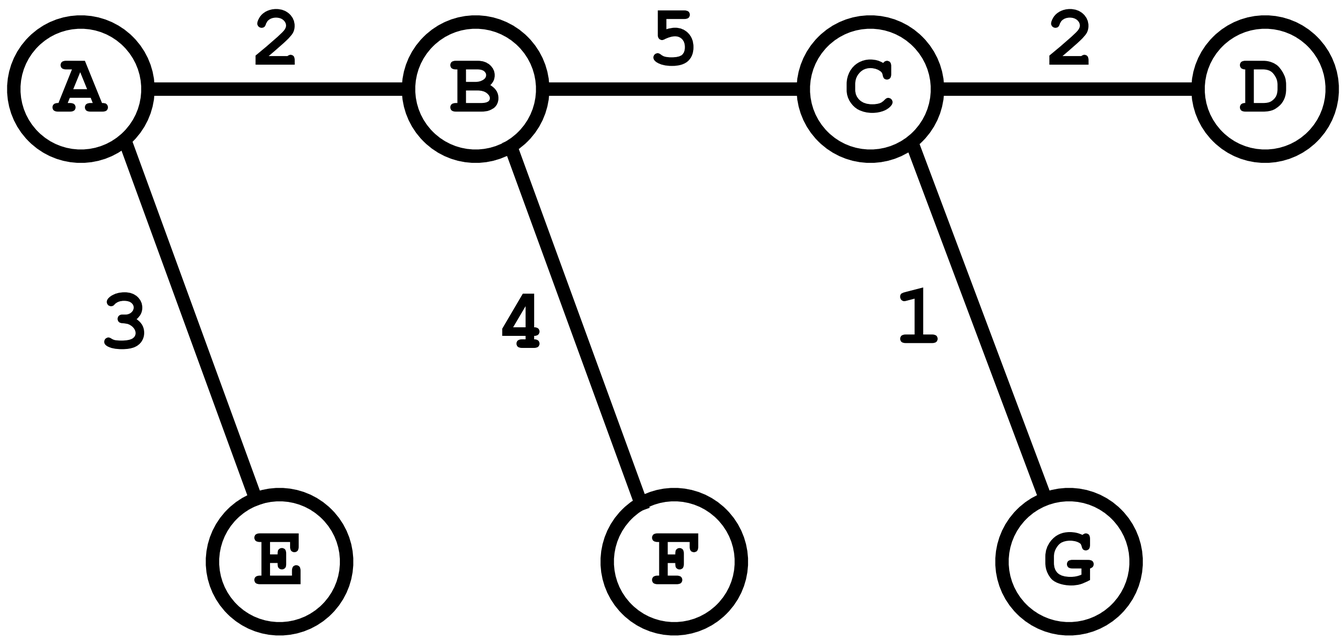

| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | 7 | ∞ | 3 | 6 | ∞ |
| | | 7 | ∞ | | 6 | ∞ |
| | | 7 | ∞ | | | 11 |
| | | | 9 | | | 8 |
| | | | | | | |

# Graphs #4




| A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|
| 0 | ∞ | ∞ | ∞ | ∞ | ∞ | ∞ |
| | 2 | ∞ | ∞ | 3 | ∞ | ∞ |
| | | 7 | ∞ | 3 | 6 | ∞ |
| | | 7 | ∞ | | 6 | ∞ |
| | | 7 | ∞ | | | 11 |
| | | | 9 | | | 8 |
| | | | 9 | | | |

# Graphs #4

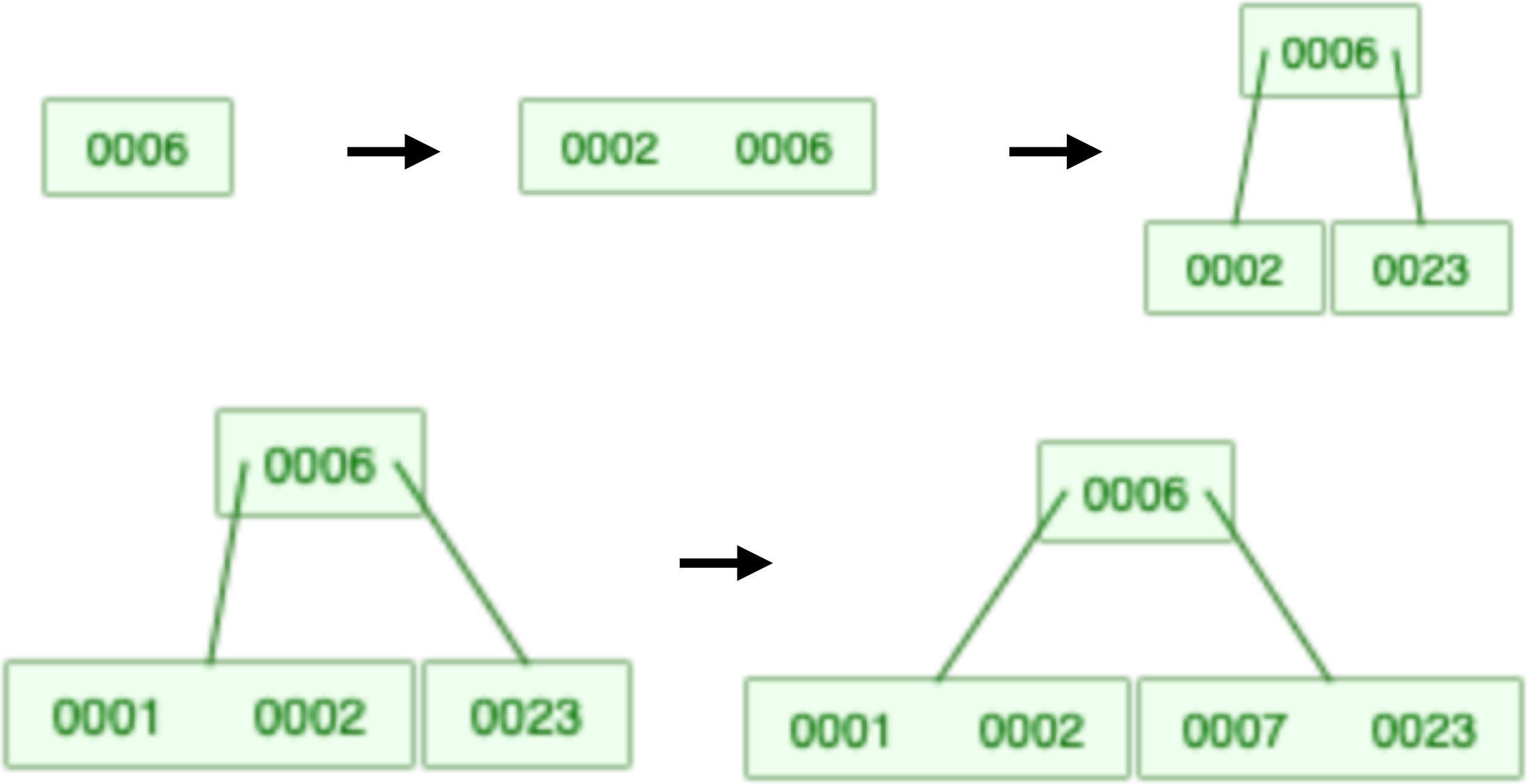


# B-Tree #1

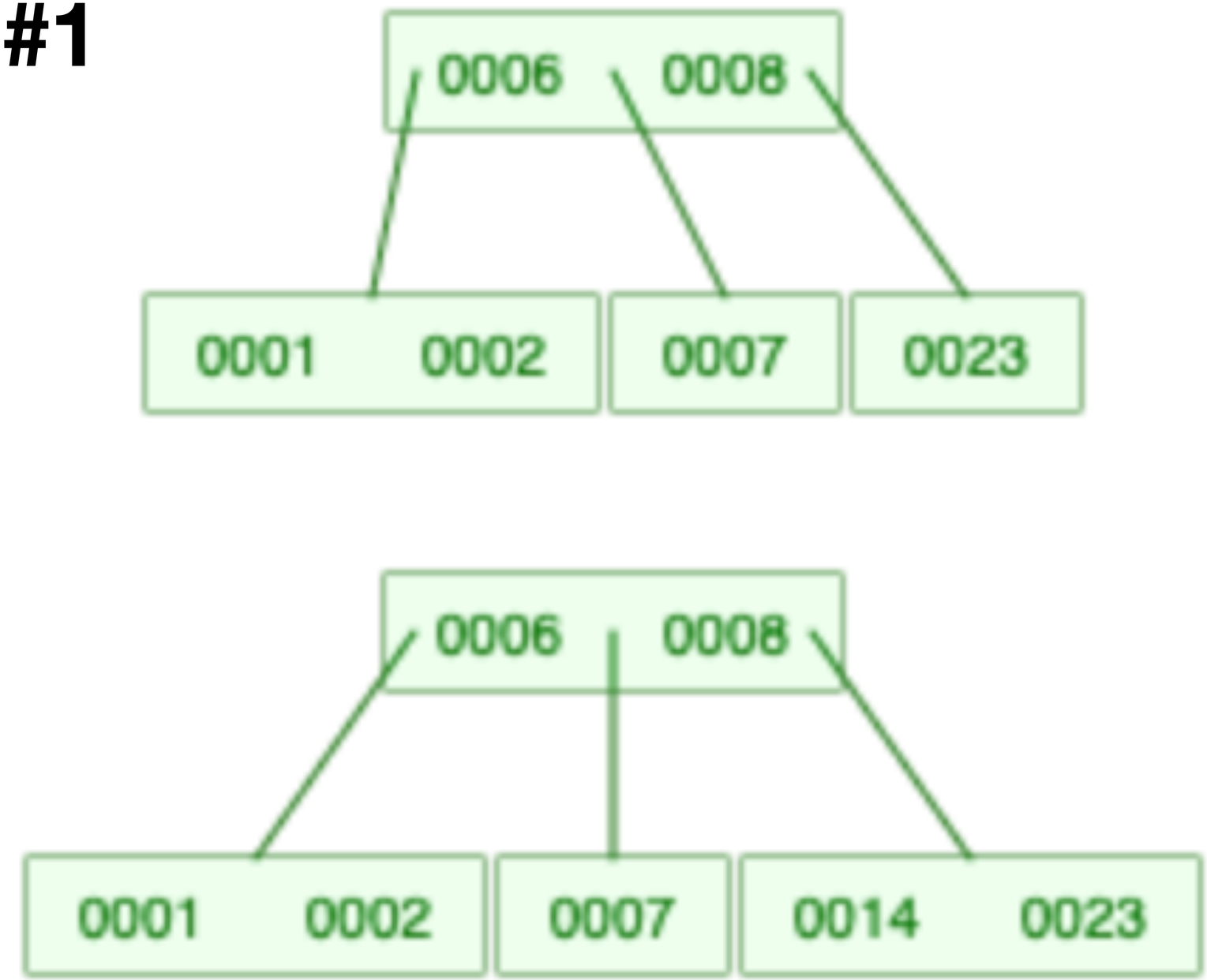
**Insert the following values into a B-Tree of degree 3 in the order in which they appear.**

**6, 2, 23, 1, 7, 8, 14, 55**

# B-Tree #1


0006
0002 0006
0006
0002 0023
0006
0001 0002 0023
0006
0001 0002 0007 0023

# B-Tree #1


0006
0008
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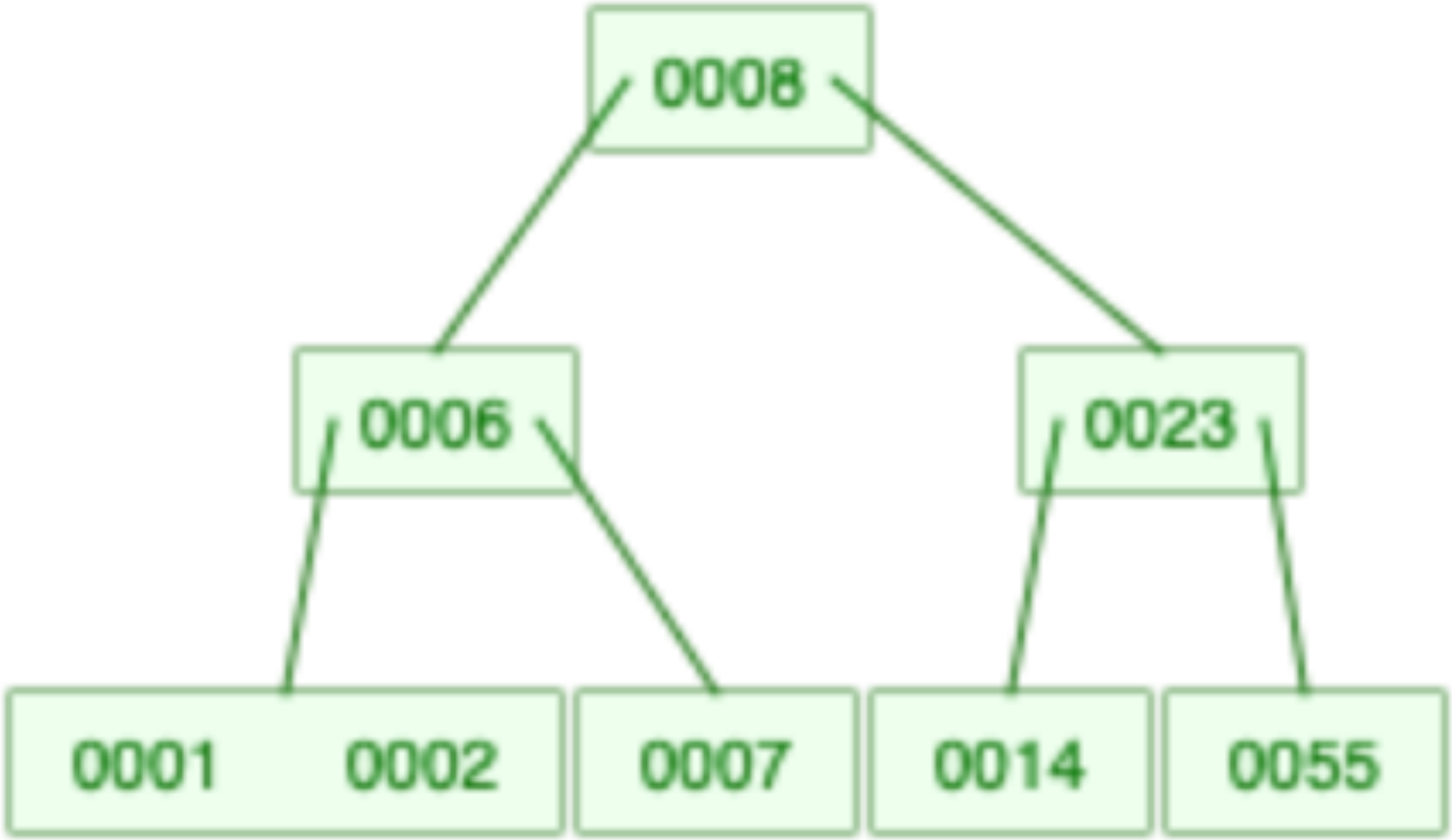
0014
0023

# B-Tree #1



# Final Exam Overview

| Section | Question | Points Possible | Question Type |
|---|---|---|---|
| BST | I | 6 | Coding |
| | II | 7 | Coding |
| | III | 7 | Coding |
| | IV | 7 | Coding |
| | V | 7 | Coding |
| | VI | 7 | Coding |
| AVL Tree | I | 6 | Coding |
| | II | 7 | Coding |
| | III | 3 | Tracing |
| Graph | I | 3 | Tracing |
| | II | 3 | Tracing |
| | III | 8 | Coding |
| | IV | 7 | Tracing |
| | V | 7 | Tracing |
| | VI | 7 | Tracing |
| B-Tree | I | 8 | Tracing |
| **Total** | **16** | **100** | |