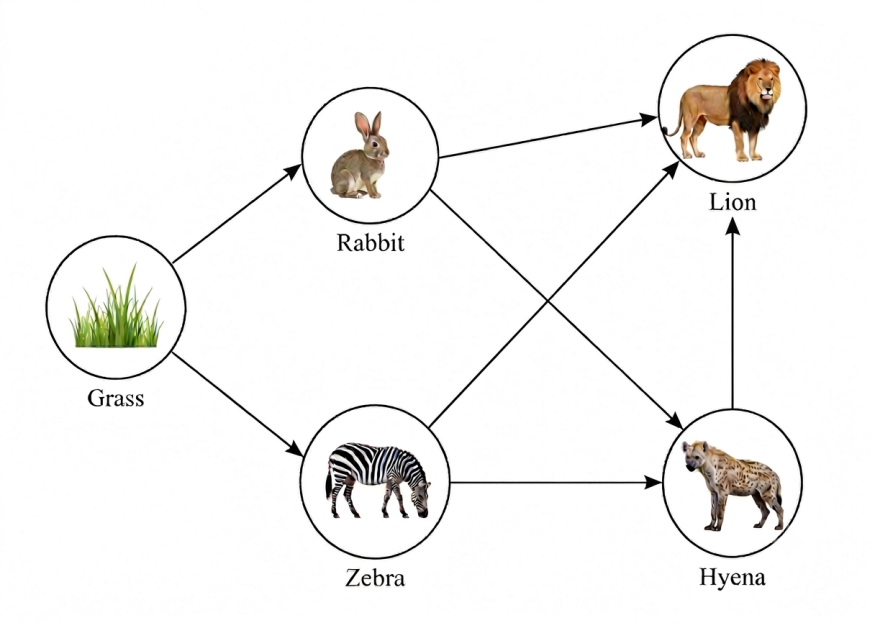
1. The diagram below represents a simplified food chain.

An arrow from one animal to another means that the first animal is eaten by the second animal.



a. What are the vertices of this graph?

Solution: `Grass, Rabbit, Zebra, Hyena, Lion`

b. What are the edges of this graph? Write them in the following format: `Grass -> Rabbit`

Solution:

- `Grass -> Rabbit`
- `Grass -> Zebra`
- `Rabbit -> Hyena`
- `Rabbit -> Lion`
- `Zebra -> Hyena`
- `Zebra -> Lion`
- `Hyena -> Lion`

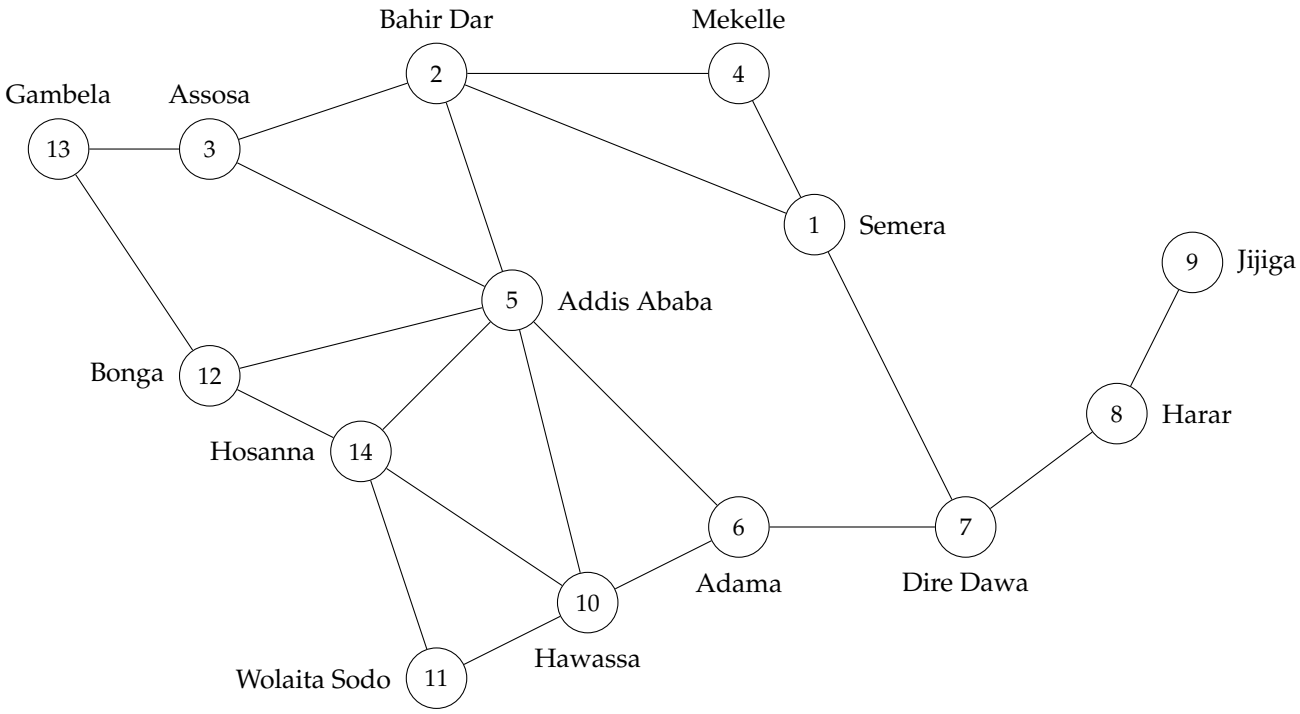
c. Complete the table. For each vertex, find its in-degree, out-degree, predecessors, and successors.

Vertex	In-degree	Out-degree	Predecessors	Successors
Grass				
Rabbit				
Zebra				
Hyena				
Lion				

Solution:

Vertex	In-degree	Out-degree	Predecessors	Successors
Grass	0	2	None	Rabbit, Zebra
Rabbit	1	2	Grass	Hyena, Lion
Zebra	1	2	Grass	Hyena, Lion
Hyena	2	1	Rabbit, Zebra	Lion
Lion	3	0	Rabbit, Zebra, Hyena	None

2. The diagram below represents a simplified road network connecting some major cities in Ethiopia. For this problem, assume that every road can be traveled in both directions.



e. Write the adjacency dictionary for this graph.

```
ethiopia_city_map = {
     1: [  4,  2,  7     ],
     2: [                ],
     3: [                ],
     4: [                ],
     5: [                ],
     6: [                ],
     7: [                ],
     8: [                ],
     9: [                ],
    10: [                ],
    11: [                ],
    12: [                ],
    13: [                ],
    14: [                ]
}
```

Solution:

```
ethiopia_city_map = {
    1: [2, 4, 7],              # Semera
```

```
    2: [1, 3, 4, 5],           # Bahir Dar
    3: [2, 5, 13],             # Assosa
    4: [1, 2],                 # Mekelle
    5: [2, 3, 6, 10, 12, 14], # Addis Ababa
    6: [5, 7, 10],             # Adama
    7: [1, 6, 8],              # Dire Dawa
    8: [7, 9],                 # Harar
    9: [8],                    # Jijiga
    10: [5, 6, 11, 14],        # Hawassa
    11: [10, 14],              # Wolaita Sodo
    12: [5, 13, 14],            # Bonga
    13: [3, 12],               # Gambela
    14: [5, 10, 11, 12]        # Hosanna
}
```

d. Find a path that starts at `Assosa` and ends at `Dire Dawa`.

Solution: One possible path is:

$$\texttt{Assosa} \rightarrow \texttt{Addis Ababa} \rightarrow \texttt{Adama} \rightarrow \texttt{Dire Dawa}$$

Using the numbers assigned to the cities:

$$\boxed{3 \rightarrow 5 \rightarrow 6 \rightarrow 7}$$