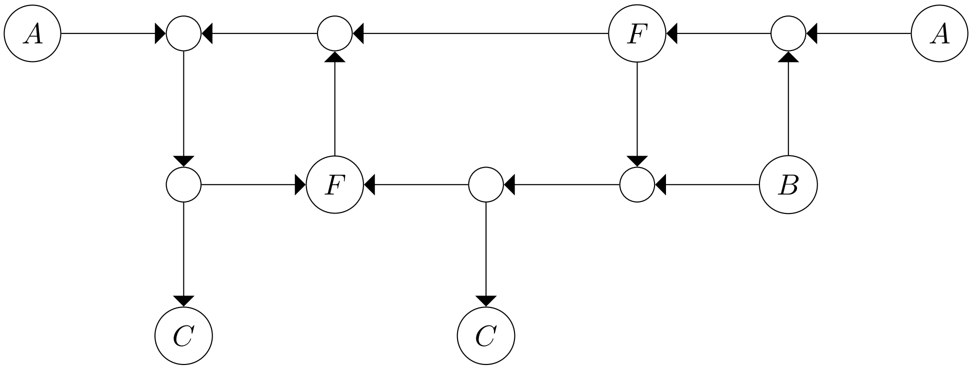
COMP331/557 Programming Assignment

Total Marks: 15

Routing and Production

Consider the following directed pipeline network that is modelled as a directed graph.



We route four different commodities a, b, x, y through the pipes. No commodity can ever flow against the indicated arc direction. Different commodities can be sent through the same pipe. For each arc, the total amount of all commodities that can flow through this pipe is bounded by 12 barrels.

The nodes that are labelled with A can produce arbitrary amounts of commodity a. The node that is labelled with B can produce arbitrary amounts of commodity b.

At each node that is not labelled with either A, B, C, or F, the amount of incoming commodity a equals the amount of outgoing commodity a. The same is true for the commodities b, x, y.

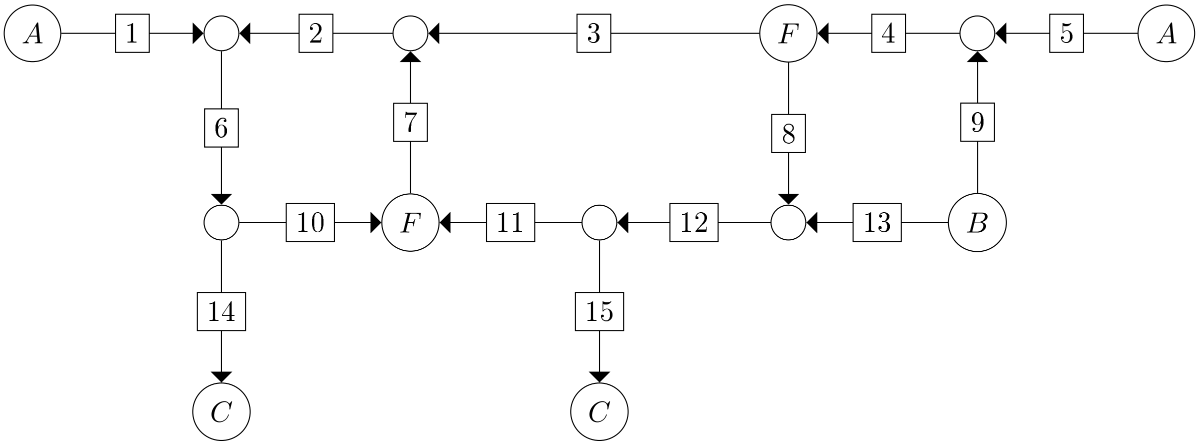
Nodes labelled with an F are called *factories*. Flow is forwarded in the same way as for other nodes, but a factory can convert commodities as follows before forwarding them.

- To produce 1 barrel of commodity x, a factory uses up 3 barrels of a and 2 barrel of b.
- To produce 1 barrel of commodity y, a factory uses up 1 barrel of a and 2 barrels of b.

Factories are not limited to integer barrel amounts. Moreover, factories are not limited to only one way of conversion. For example, a factory can use 3.5 barrels of a and 3 barrels of b to produce 1 barrels of x and 0.5 barrel of y.

Nodes labelled with C are called *customers*. A customer pays £3 for a barrel of commodity x, and £4 for a barrel of commodity y. Customers buy as much of commodity x and y as they can. Fractional barrel amounts are acceptable. Customers never buy commodity a or b.

We enumerate the 15 arcs as follows:



For each are introduce 4 variables that represent how much of the 4 commodities (a, b, x, and y) is sent through that arc. For example, the 4 variables for arc 1 are $a1, b1, x1$, and $y1$. The 4 variables for arc 15 are $a15, b15, x15$, and $y15$ The LP contains the obvious flow conservation and capacity constraints.

The optimisation problem is to maximise the amount of money that the customers pay.

- Model this problem as a linear program (LP) and write the corresponding `assignment.lp` file. **[Marks: 10]**
- Use the `glpsol` to find an optimal solution: Run the command “glpsol –lp assignment.lp -o output.txt". **[Marks: 5]**

Submission format: Put the following in a single .zip file.

- `assignment.lp` file.
- output.txt.