## ❖Names and IDs:

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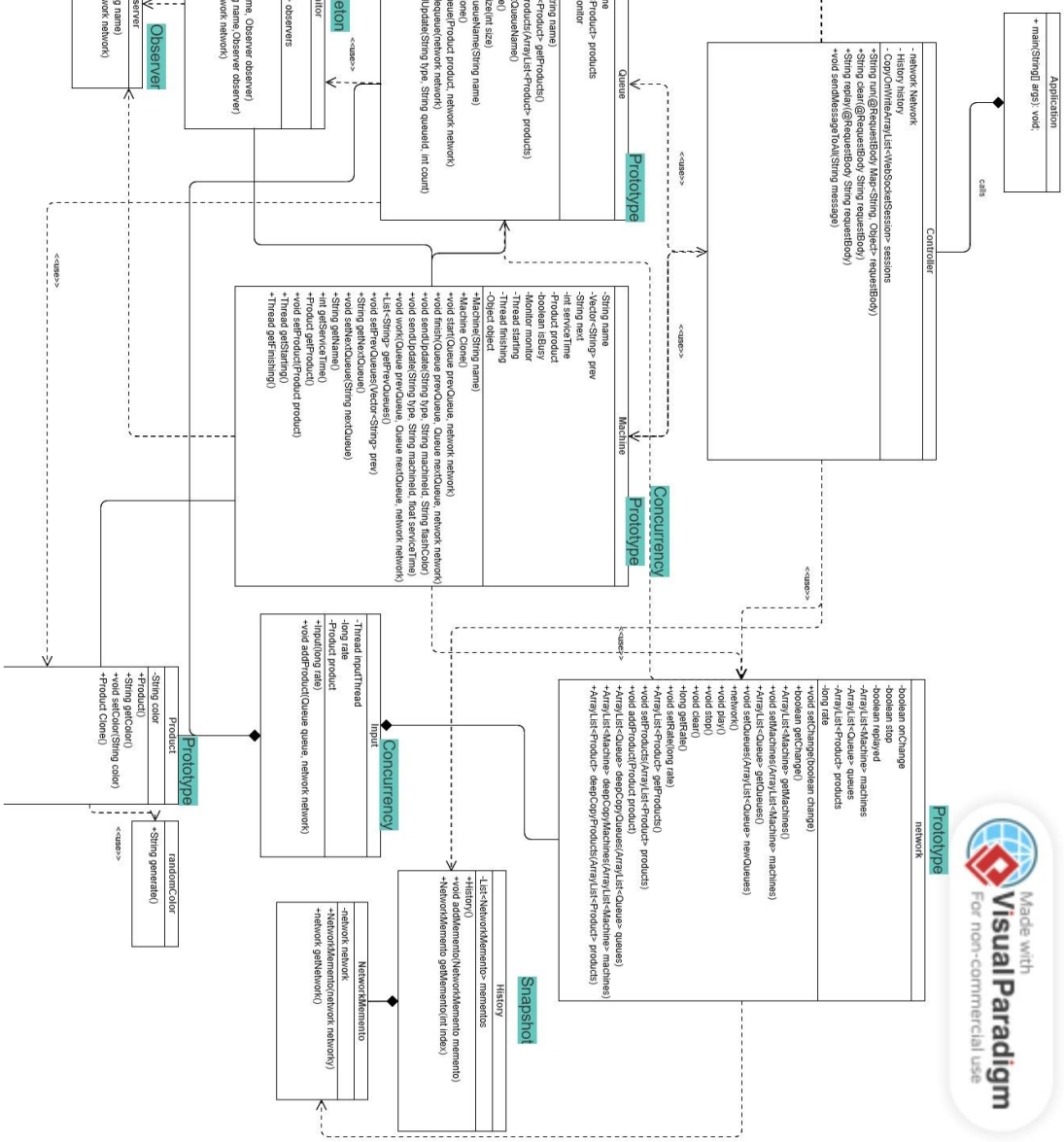
## ❖Steps required to run code:

1. Backend:
    - Open the Backend folder using IntelliJ IDE or any other IDE, run the Application.java class.
2. Frontend:
    - Open the Frontend folder using visual studio IDE, then open the terminal of the IDE, and write “npm install” in the terminal.
    - Then write “npm run dev” in the terminal to open the project, usually on port “http://localhost:5173/”
3. Then you can use the application.

# ❖UML diagram:


Application
+ main(String[] args): void
calls
Controller
- network Network
- History history
- CopyOnWriteArrayList<WebSocketSession> sessions
+String run(@RequestBody Map<String, Object> requestBody)
+String clear(@RequestBody String requestBody)
+String replay(@RequestBody String requestBody)
+void sendMessageToAll(String message)
Prototype
network
-boolean onChange
-boolean stop
-boolean replayed
-ArrayList<Machine> machines
-ArrayList<Queue> queues
-ArrayList<Product> products
-long rate
+void setChange(boolean change)
+boolean getChange()
+void setMachines(ArrayList<Machine> machines)
+ArrayList<Machine> getMachines()
+void setQueues(ArrayList<Queue> newQueues)
+ArrayList<Queue> getQueues()
+network()
+void play()
+void stop()
+void clear()
+long getRate()
+void setRate(long rate)
+ArrayList<Product> getProducts()
+void setProducts(ArrayList<Product> products)
+void addProduct(Product product)
+ArrayList<Queue> deepCopyQueues(ArrayList<Queue> queues)
+ArrayList<Machine> deepCopyMachines(ArrayList<Machine> machines)
+ArrayList<Product> deepCopyProducts(ArrayList<Product> products)
WebSocketConfig
+void registerWebSocketHandlers(WebSocketHandlerRegistry registry)
implements
WebSocketConfigurer
WebSocketHandler
+void afterConnectionEstablished(WebSocketSession session)
+void handleTextMessage(WebSocketSession session, TextMessage message)
+void afterConnectionClosed(WebSocketSession session, CloseStatus status)
extends
TextWebSocketHandler
Queue
Prototype
-String name
-ArrayList<Product> products
-Monitor monitor
-int size
+Queue(String name)
+ArrayList<Product> getProducts()
+void setProducts(ArrayList<Product> products)
+String getQueueName()
+int getSize()
+void setSize(int size)
+void setQueueName(String name)
+Queue Clone()
+void enqueue(Product product, network network)
+Product dequeue(network network)
+void sendUpdate(String type, String queueId, int count)
Machine
Concurrency
Prototype
-String name
-Vector<String> prev
-String next
-int serviceTime
-Product product
-boolean isBusy
-Monitor monitor
-Thread starting
-Thread finishing
-Object object
+Machine(String name)
+Machine Clone()
+void start(Queue prevQueue, network network)
+void finish(Queue prevQueue, Queue nextQueue, network network)
+void sendUpdate(String type, String machineId, float serviceTime)
+void sendUpdate(String type, String machineId, String flashColor)
+void work(Queue prevQueue, Queue nextQueue, network network)
+List<String> getPrevQueues()
+void setPrevQueues(Vector<String> prev)
+String getNext(Queue)
+void setNextQueue(String nextQueue)
+String getName()
+int getServiceTime()
+Product getProduct()
+void setProduct(Product product)
+Thread getStarting()
+Thread getFinishing()
Singleton
Monitor
-Monitor instance
-HashMap<String, Observer> observers
+Monitor()
+Monitor getInstance()
+void addObserver(String name, Observer observer)
+void removeObserver(String name, Observer observer)
+void notify(String name, network network)
Observer
Observer
+Observer(String name)
void update(network network)
Concurrency
Input
-Thread inputThread
-long rate
-Product product
+input(long rate)
+void addProduct(Queue queue, network network)
Prototype
Product
-String color
+Product()
+String getColor()
+void setColor(String color)
+Product Clone()
randomColor
+String generate()
Snapshot
History
-List<NetworkMemento> mementos
+History()
+void addMemento(NetworkMemento memento)
+NetworkMemento getMemento(int index)
NetworkMemento
-network network
+NetworkMemento(network network)
+network getNetwork()
«use»
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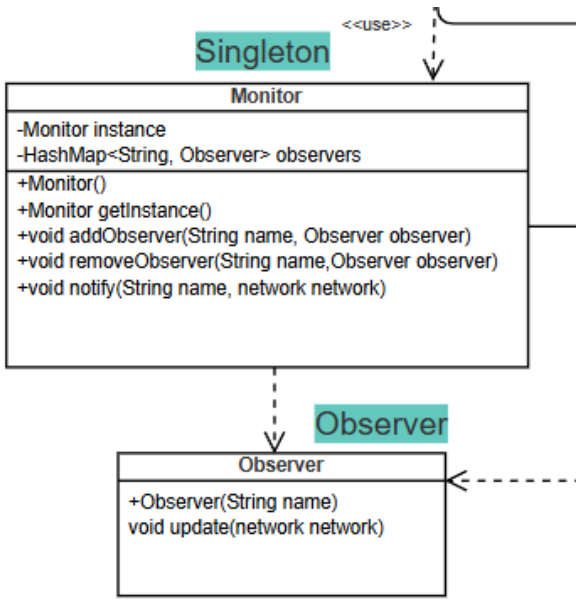
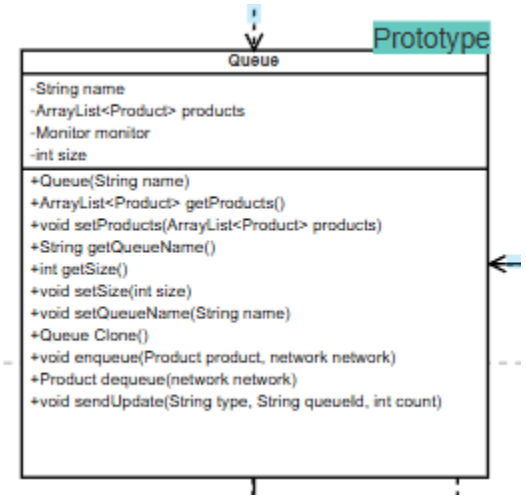
# ❖Design Patterns:

1. Singleton design pattern
   - This design pattern ensures that there is only one instance of the **Monitor** class throughout the application. This central **Monitor** instance manages the **observers**. Singelton helps conserve memory and enables reusability.

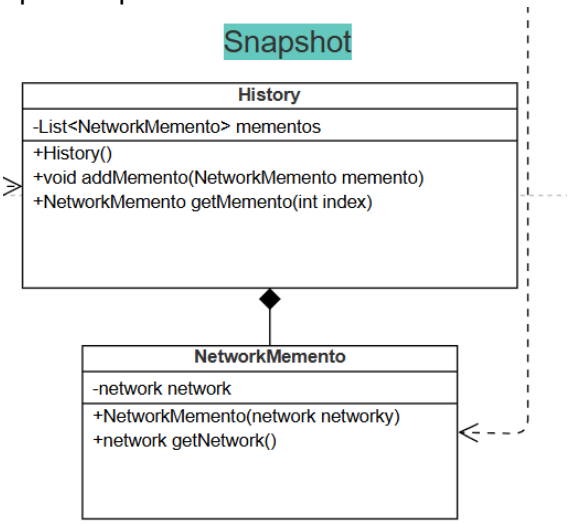
2. Observer design pattern
   - This design pattern was used to implement a system where objects **(observers)** are notified of changes in the **network**. The **Monitor** class maintains a list of **observers**, and when the state of the **network** changes, all registered **observers** are updated accordingly.



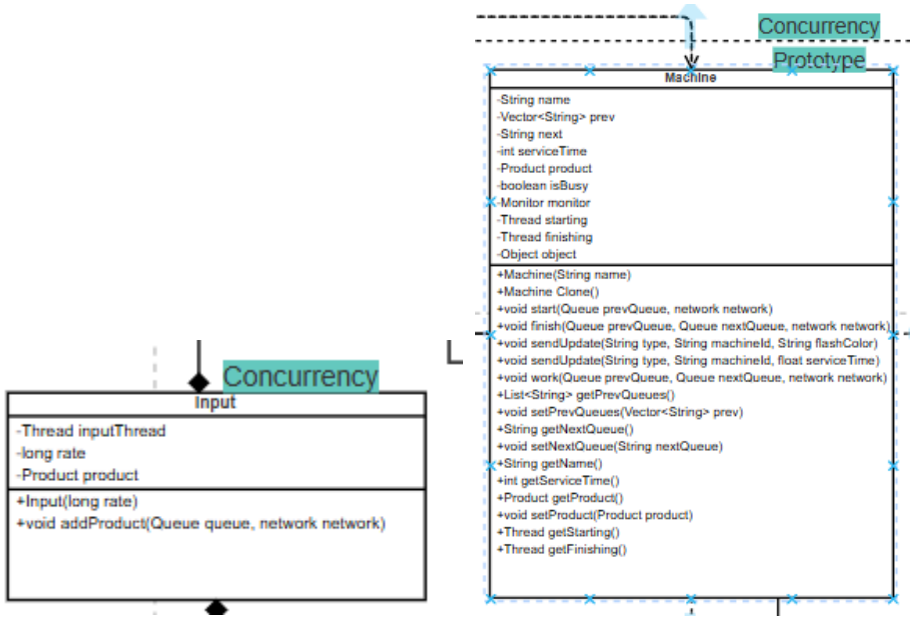
3. Prototype design pattern
   - This design pattern enables the cloning of **Machine, Queue, Product and Network** objects. It help maximize the efficiency of object creation by cloning from an existing template.




4. Snapshot design pattern
   - This design pattern was implemented in the **NetworkMemento** and **History** classes. It allows capturing and restoring the state of the **network** at specific points in time.



5. Concurrency design pattern
   - This design pattern was implemented in **Machine** and **Input** to handle parallel processing. The classes uses concurrency by using threads to manage and perform tasks asynchronously, allowing multiple machines to operate simultaneously.

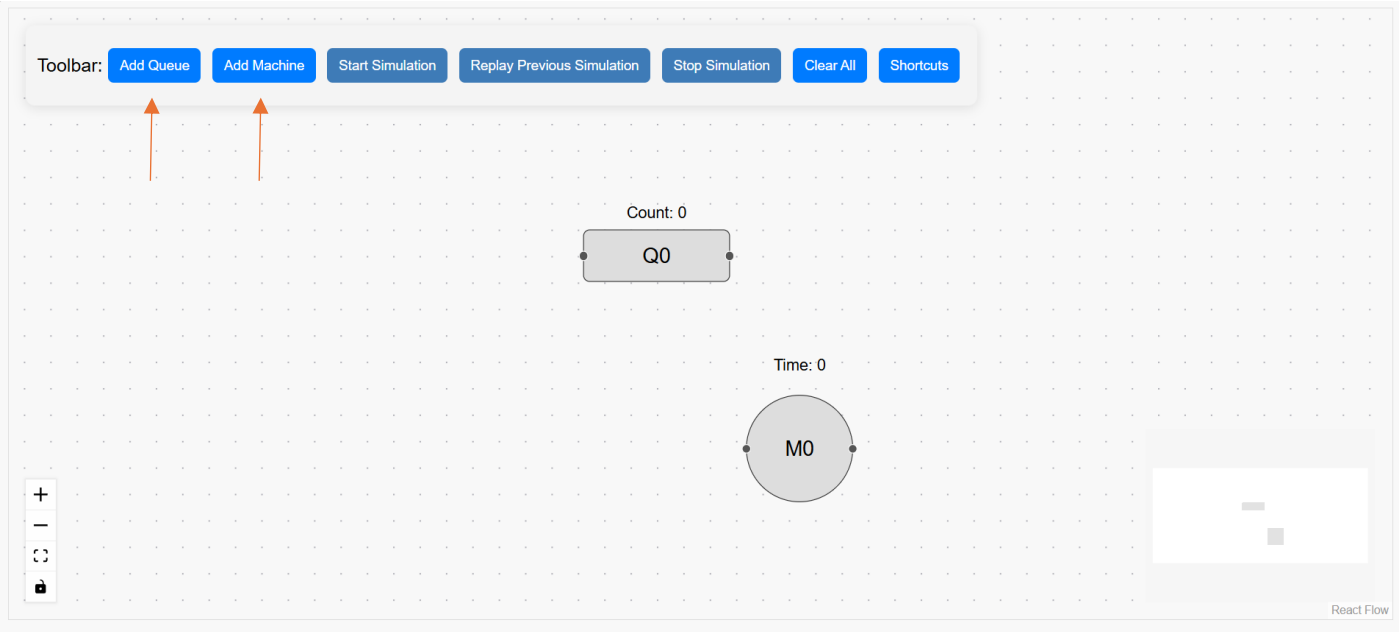



## ❖Design decisions:

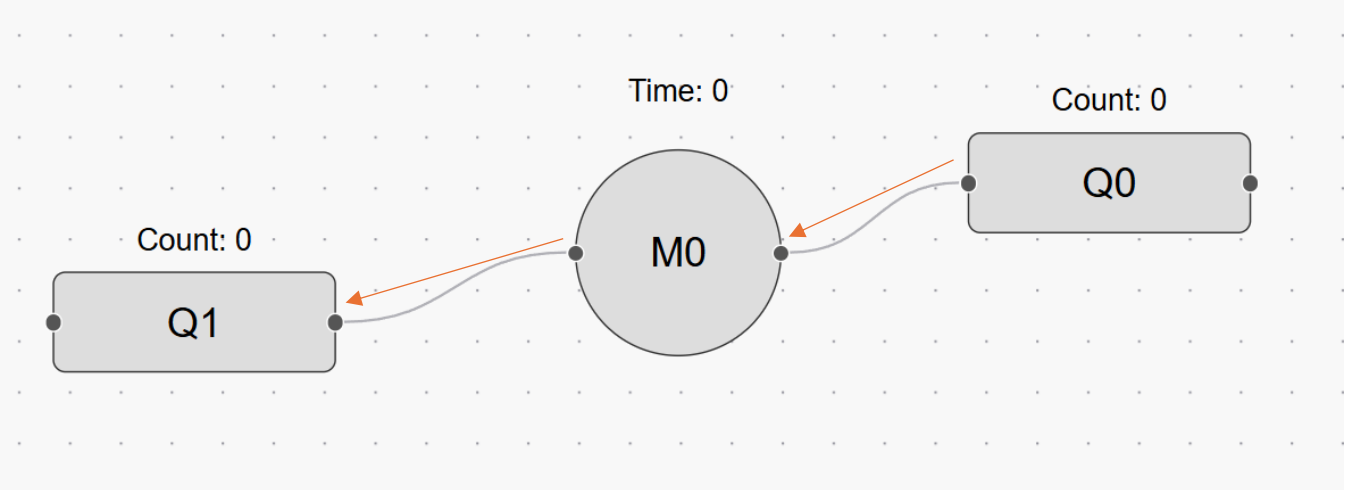
- Input (First) Queue must be Q0
- User can stop the simulation completely but can’t pause/resume it.

# ❖Snapshots UI and User guide:

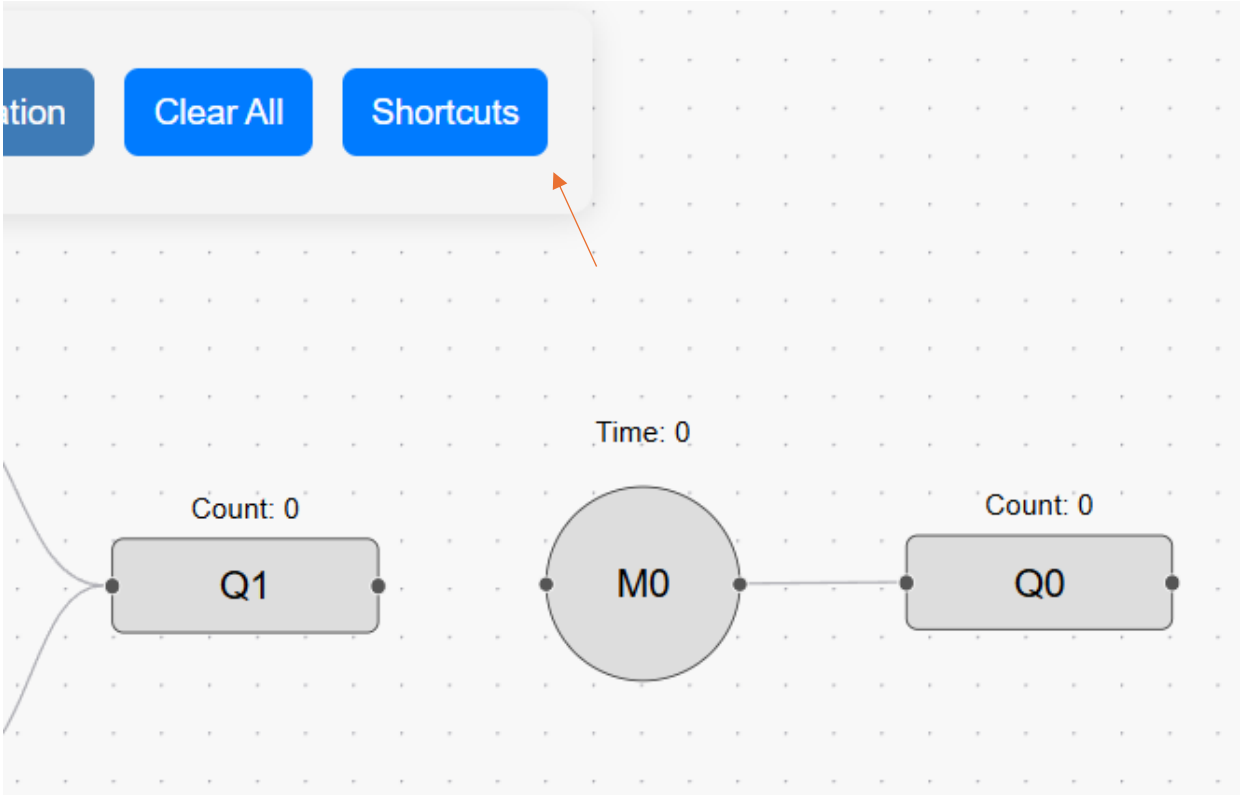
1. Start by **adding** the Queues and Machines that you want, when you click an “Add” button, a Queue/Machine will appear on the board.



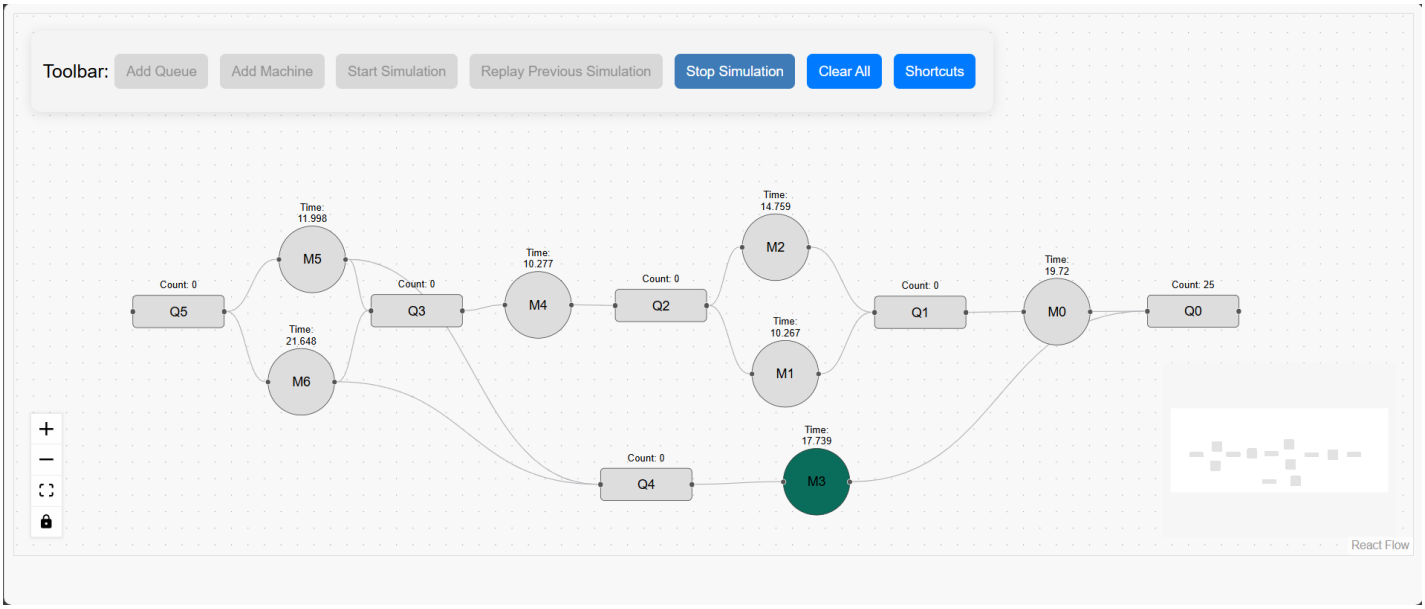

2. Rearrange the Queues and Machines by dragging them, then connect them by grabbing and dragging one end to the other.
   Note: The flow of simulation is from right to left, meaning that Q0 is the input and Q1 is the final output, so keep that in mind!



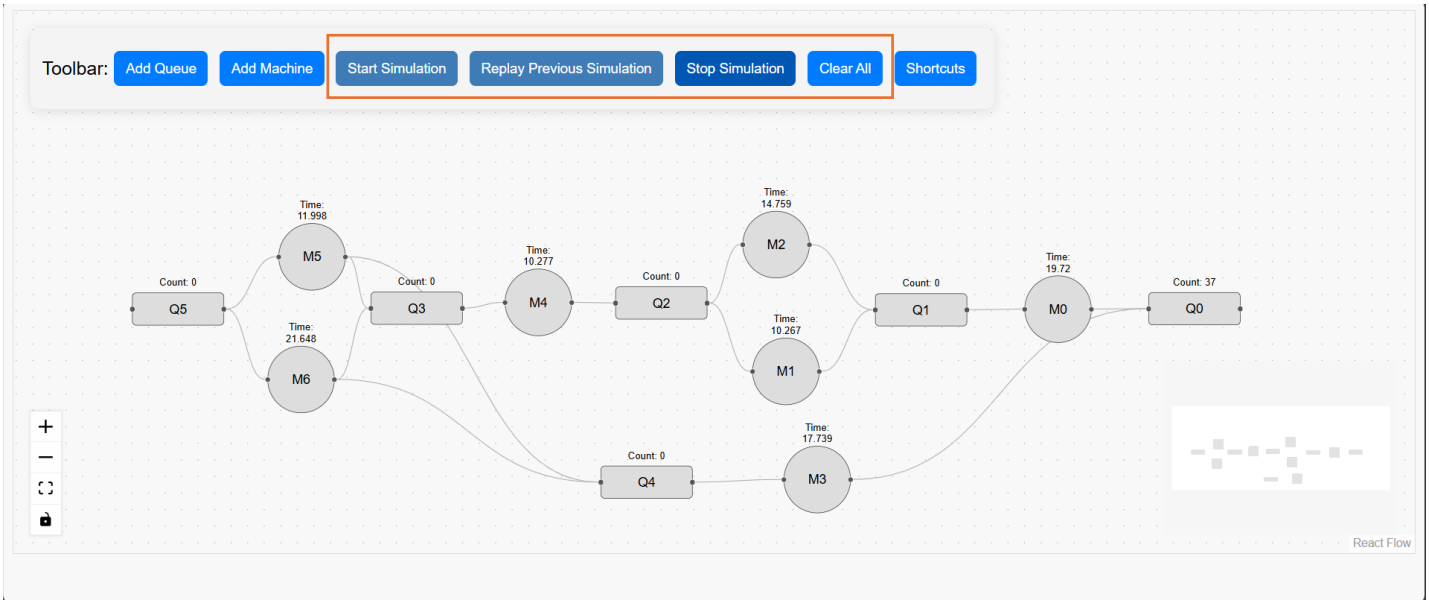
3. Made a mistake? Delete a Queue / Machine or an edge by selecting it and clicking “**Backspace**” on the keyboard, you can also see this info in the “**Shortcuts**” button in case you forgot what to press.



4. When all good, press “**Start Simulation**” to begin. You’ll see the current number of products in each Queue and the time a Machine takes to service/process a product.
   Each machine will flash the color of the product it’s inside when it finishes servicing the product,
   Each product from Q0 up till Q5 will have a unique random color.



5. Press “**Stop Simulation**” to stop the simulation.
   Press **“Clear All”** to start fresh (will obviously stop simulation).
   You can start simulation again with new random values and colors when you click “**Start Simulation**”.
   Or click “**Replay Previous Simulation**” to replay the last played simulation with the same values and colors!




6. Lastly, you may have wondered what’s in the bottom left.
   It’s a control panel! You can
   1- Zoom in
   2- Zoom out
   3- Fit view
   4- Toggle interactivity, which includes (Select, Delete, Drag)
   The bottom right is just a mini-map (overview) of the whole board.