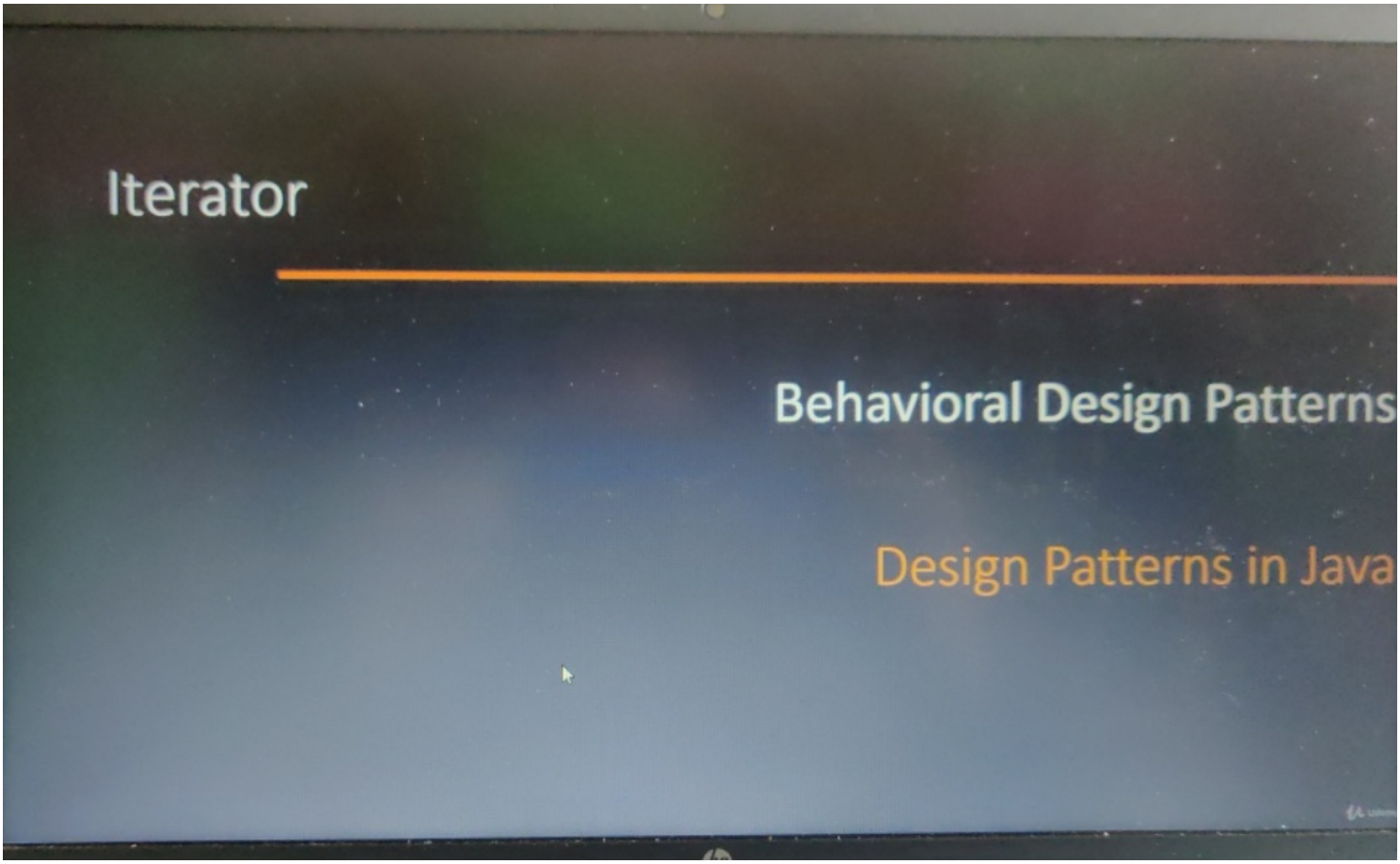
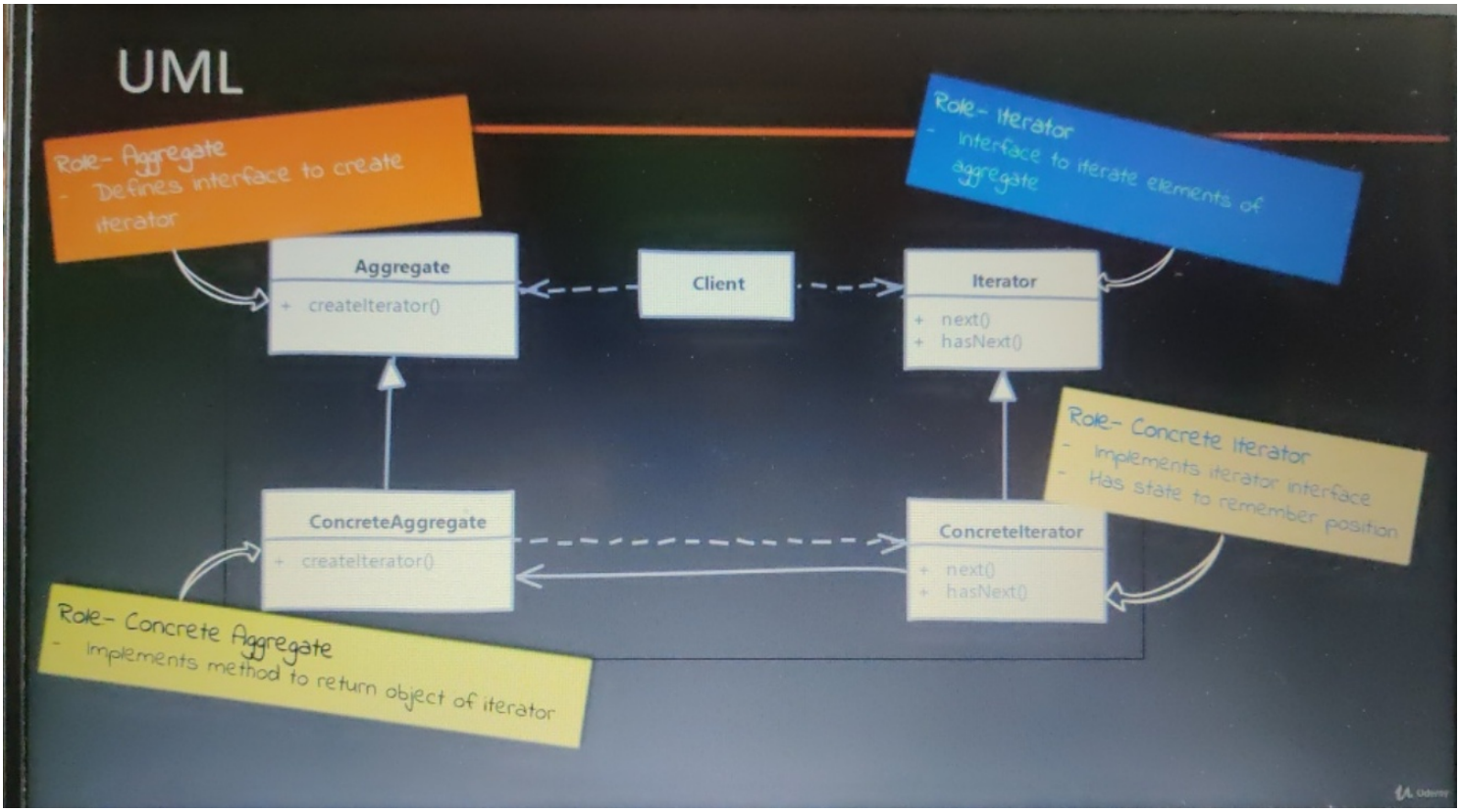

Iterator
Behavioral Design Patterns
Design Patterns in Java

What is Iterator?

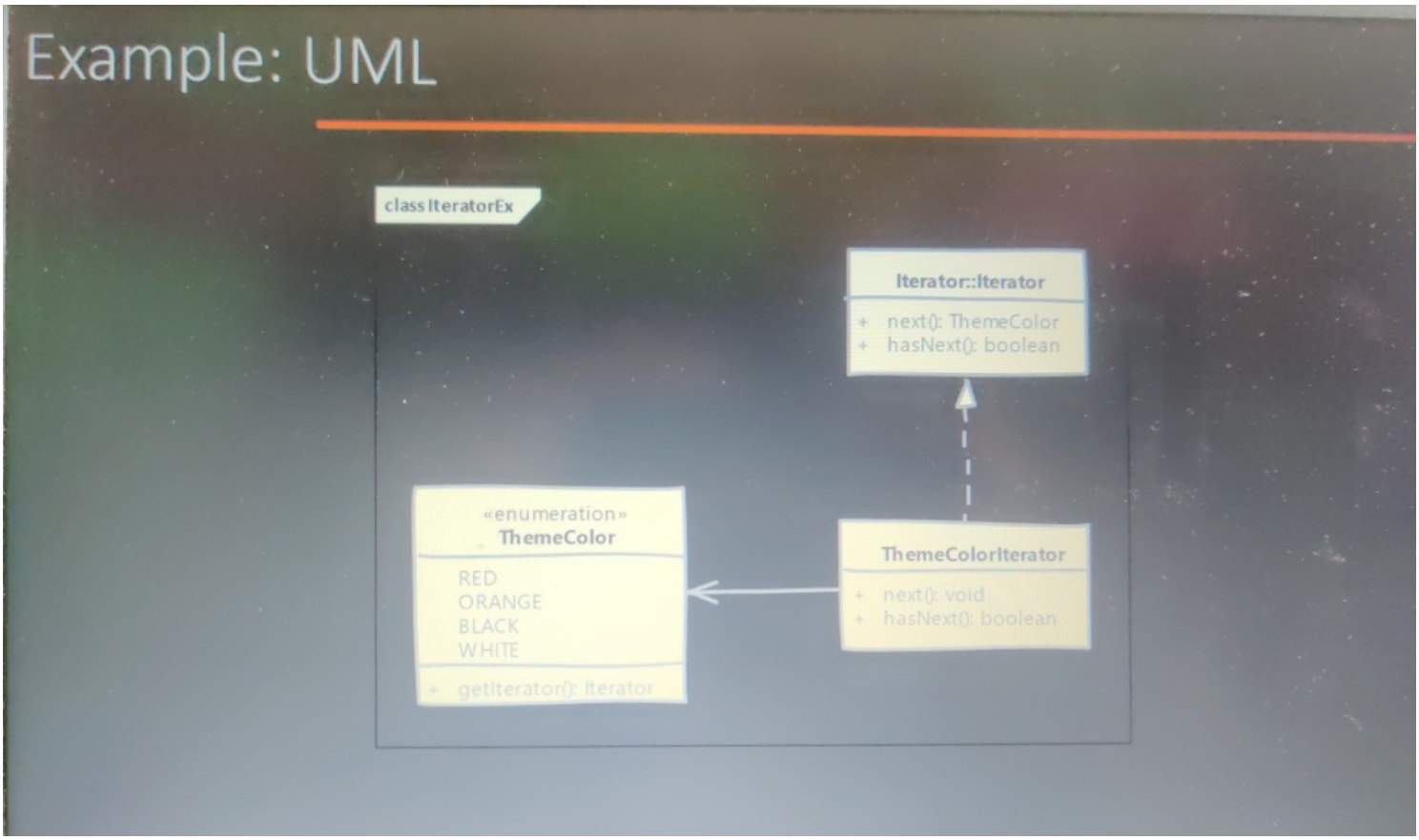
- Iterator allows a way to access elements/children of an aggregate object in sequence while hiding the actual internal data structure used.
- In Java language iterators are integral part of collection frameworks and they are implementations of this design pattern.
- Iterators are stateful, meaning an iterator object remembers its position while iterating.
- Iterators can become out of sync if the underlying collection is changed while a code is using iterator.


UML
Role- Aggregate
- Defines interface to create iterator
Role- Iterator
- Interface to iterate elements of aggregate
Aggregate
+ createIterator()
Client
Iterator
+ next()
+ hasNext()
Role- Concrete Iterator
- Implements iterator interface
- Has state to remember position
ConcreteAggregate
+ createIterator()
ConcreteIterator
+ next()
+ hasNext()
Role- Concrete Aggregate
- Implements method to return object of iterator

Implement Iterator

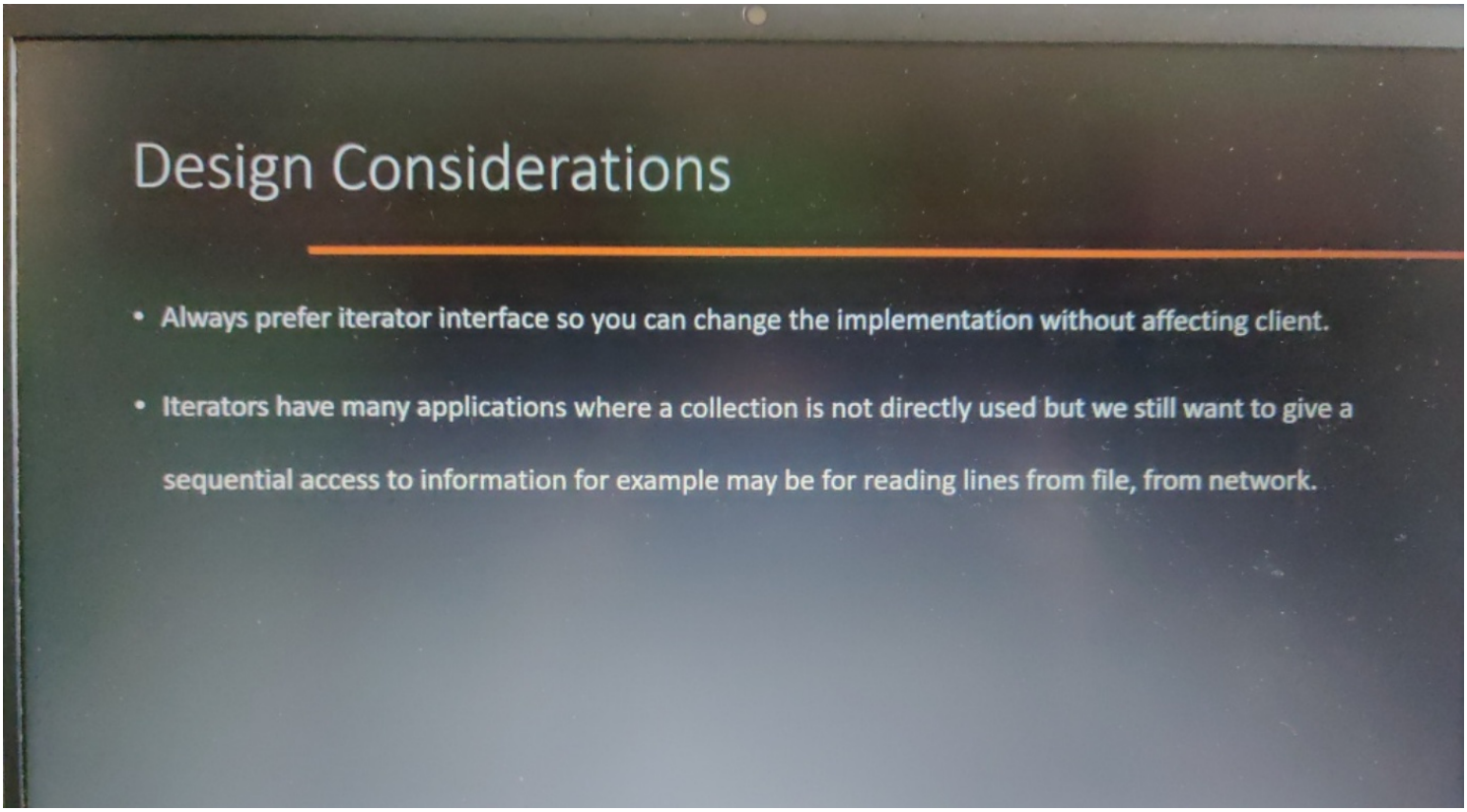
- We start by defining Iterator interface
  - Iterator has methods to check whether there is an element available in sequence & to get that element
- We then implement the Iterator in a class. This is typically an inner class in our concrete aggregate. Making it an inner class makes it easy to access internal data structures
- Concrete iterator needs to maintain state to tell its position in collection of aggregate. If the inner collection changes it can throw an exception to indicate invalid state.

Example: UML


class IteratorEx
Iterator::Iterator
+ next(): ThemeColor
+ hasNext(): boolean
«enumeration»
ThemeColor
RED
ORANGE
BLACK
WHITE
+ getIterator(): Iterator
ThemeColorIterator
+ next(): void
+ hasNext(): boolean

Implementation Considerations

- Detecting change to underlying data structure while some code is using an iterator is important to notify to the client because then our iterator may not work correctly.
- Having our iterator implementation as inner class makes it easy to access internal collection of aggregate objects.

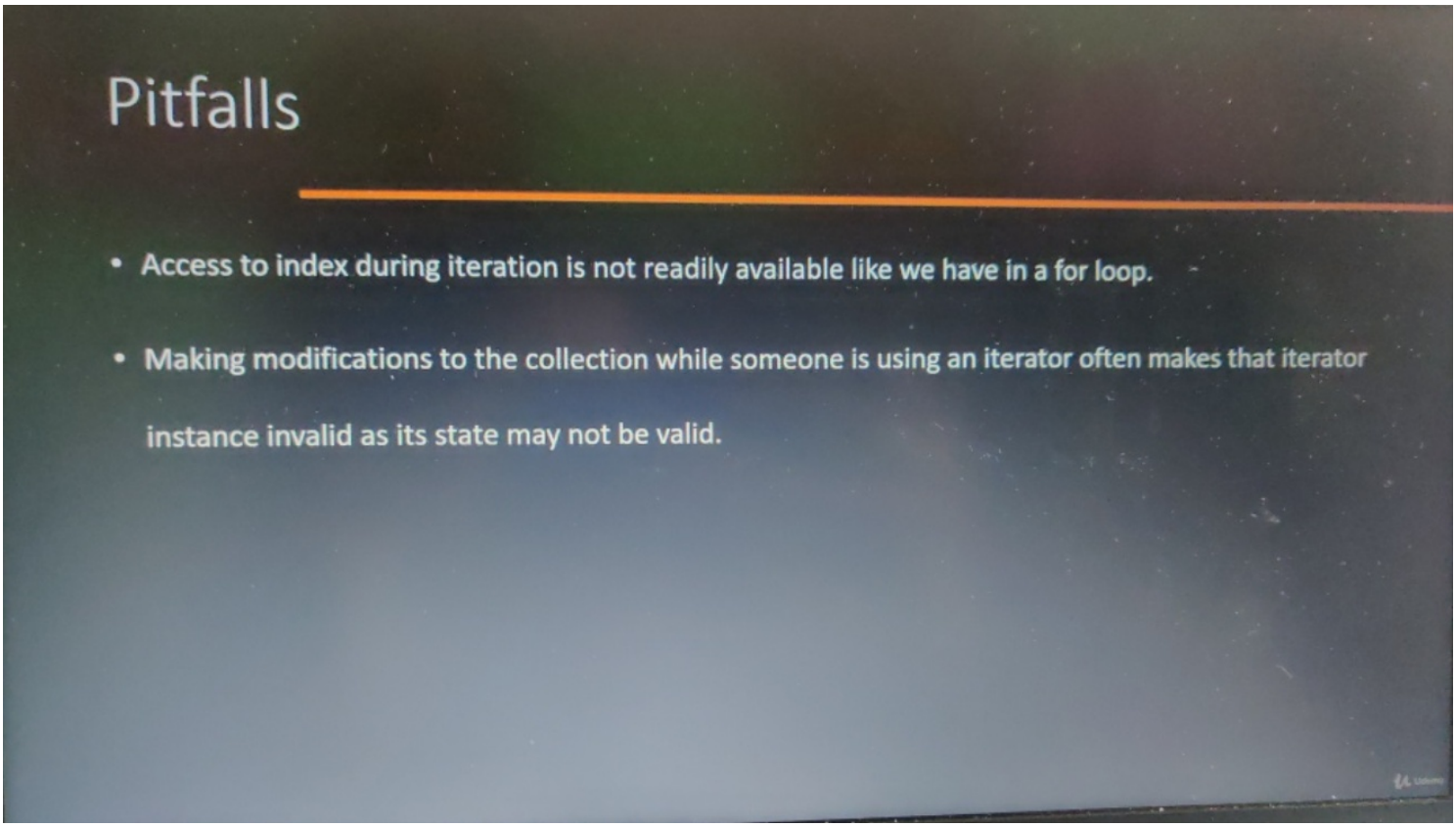

Design Considerations
• Always prefer iterator interface so you can change the implementation without affecting client.
• Iterators have many applications where a collection is not directly used but we still want to give a sequential access to information for example may be for reading lines from file, from network.

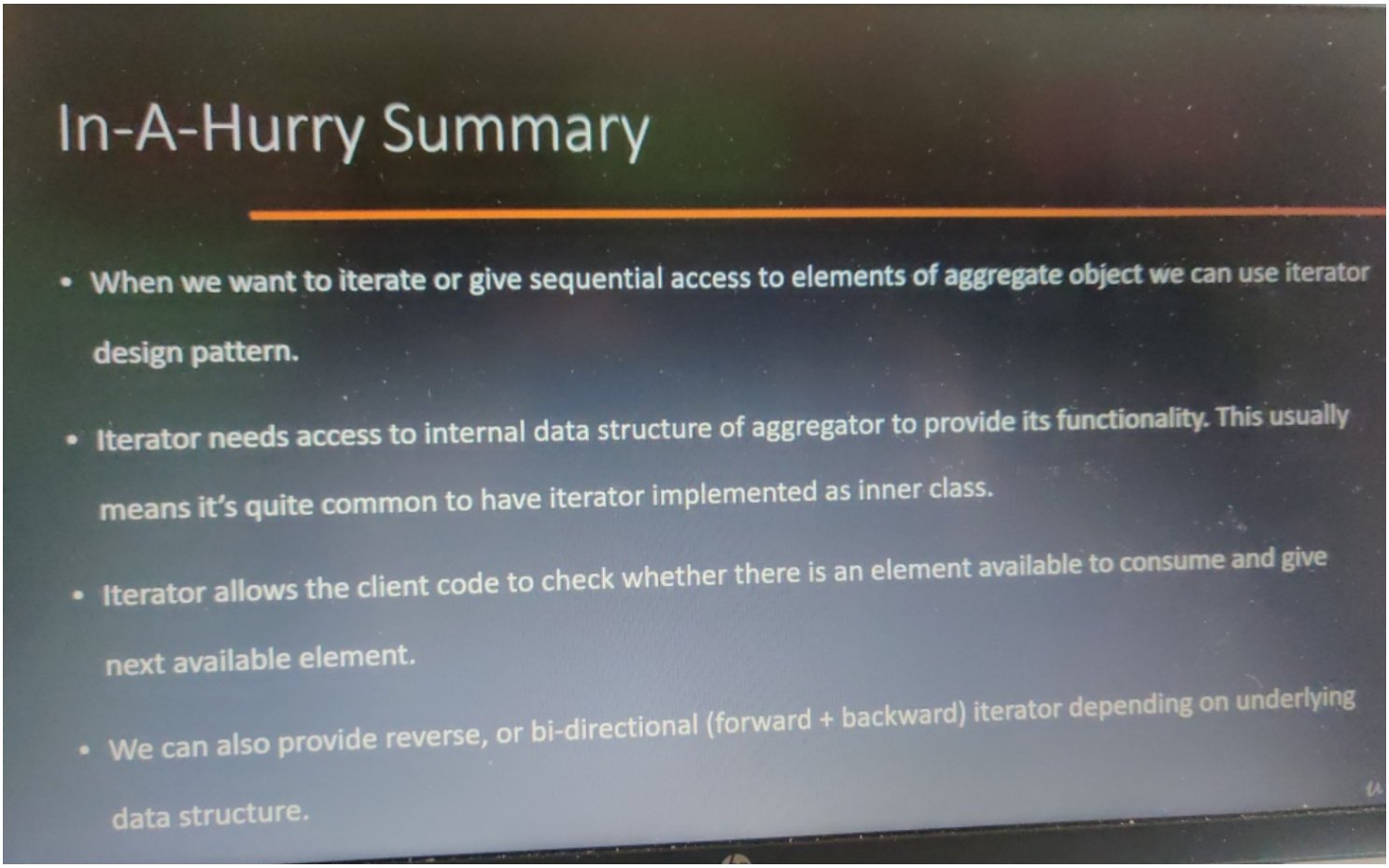
Examples of Iterator

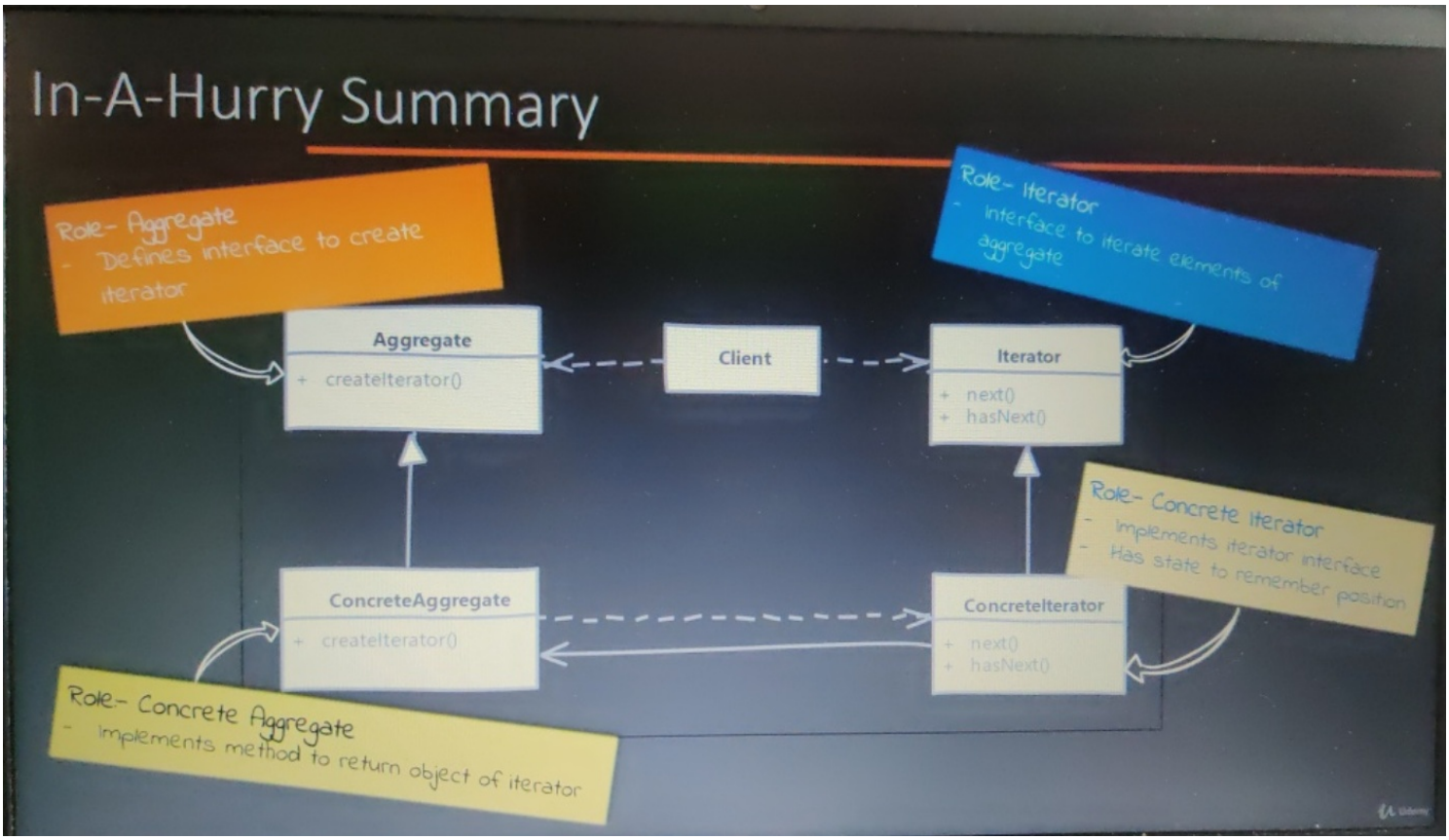
- Yup! The iterator classes in Java's collection framework are great examples of iterator. ☺ The concrete iterators are typically inner classes in each collection class implementing java.util.Iterator interface.
- The java.util.Scanner class is also an example of Iterator pattern. This class supports InputStream as well and allows to iterate over a stream.

```
Scanner sc = new Scanner(System.in);
//read an integer from input stream
int i = sc.nextInt();
```

- The javax.xml.stream.XMLEventReader class is also an iterator. This class turns the XML into a stream of event objects.


Pitfalls
• Access to index during iteration is not readily available like we have in a for loop.
• Making modifications to the collection while someone is using an iterator often makes that iterator instance invalid as its state may not be valid.


In-A-Hurry Summary
• When we want to iterate or give sequential access to elements of aggregate object we can use iterator design pattern.
• Iterator needs access to internal data structure of aggregator to provide its functionality. This usually means it's quite common to have iterator implemented as inner class.
• Iterator allows the client code to check whether there is an element available to consume and give next available element.
• We can also provide reverse, or bi-directional (forward + backward) iterator depending on underlying data structure.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