PG5600 **iOS programmering**

Lesson # 3

Reminder

Everything is on github https://github.com/BeiningBogen/iOS-Kristiania

Review

- Functions
- Closures
- Enumeration
- Classes & Structs
- Stored Properties
- Methods
- Access control

Today - Swift (cont'd)

- Subscripts, Constructors and Inheritance
- ARC
- Optionals & Optional chaining
- Guard
- Type casting & Nested types
- Protocols
- Extensions
- Generics

Subscripts

- Shortcuts to retrieve and insert items in a collection, list, or sequence
- Set and get in the same way
- Can be defined in classes, structures and enums

Subscripts (Cont'd)

```swift
// Dictionary structures implement subscripts

var studentsBySubject = ["ios": 10000, "android": 90, "wp": 10]

// Access and set items using the key
print(studentsBySubject["ios"]) // 10000
studentsBySubject["ios"] = 500000
```

Subscripts (Cont'd)

— As computed properties, they can be read-write or read only

```
class ExampleSubscript {
    subscript(<parameters>) -> <returnType> {
        // Getter is mandatory
        get {
            <statements>
        }
        // Setter is optional
        set {
            <statements>
        }
    }
}
```

Subscript overloading

- Define as many subscripts as you want
- Swift is smart at guessing which to use (based on type)

```
class ExampleSubscript {
    //...

    subscript(pattern: String) -> Bool {

    }

    subscript(willBeDone: Bool) -> String {

    }

    //...
}
```

Constructors

- Called Initializers in the Swift world
- Written with the init keyword
- Properties can be set in the constructor

```
class LivingThing {
    let birth: Date

    init(birth: Date) {
        self.birth = birth
    }
}

var aThing = LivingThing(birth: Date())
```

Constructors (Cont'd)

— Optionals and values with default value do not need to be set in the constructor

```
class LivingThing {
    let birth: Date
    var death: Date?
    var isAlive: Bool = true

    init(birth: Date) {
        self.birth = birth
    }
}

var livingThing = LivingThing(birth: NSDate())
```

Constructors (Cont'd)

- You can have several constructors and they can call each other
- There are two different types of constructors...

Constructors (Cont'd)

Designated

- Primary constructor that must initialise all non-optional, non-initialised properties
- Must call it's superclass (by inheritance)
- There are often very few or just one **Designated** constructor
- All classes must have at least one, unless you have default values on all properties

Constructors (Cont'd)

Convenience

- Typically sets up a given state for the class
- Often requires fewer parameters
- Use them as a shortcut to set up a frequently used state
- **Convenience** constructors must first call a **Designated** constructor

Constructors (Cont'd)

```swift
class LivingThing {
    let birth: Date
    var death: Date?
    var isAlive: Bool = true

    init(birth: Date) {
        self.birth = birth
    }

    convenience init() {
      self.init(birth: Date())
      self.isAlive = false // has to be after self.init
    }
}

var livingThing = LivingThing(birth: Date())

// convenience
var livingThing2 = LivingThing()
```

Inheritance

A class can inherit

— Methods
— Properties

and ...... everything else from another class

Inheritance (Cont'd)

- A class that inherits from another is called **subclass**
- The class that **subclass** inherits from is called **superclass**
- A class that does not inherit from anyone is called **base class**
- A **subclass** can call methods, properties and subscripts on **superclass**
- **subclass** can override a **superclass**'s methods, properties and subscripts

Inheritance (Cont'd)

```swift
// Base classes and superclasses

class LivingThing {
    let birth: Date
    var death: Date?

    // Cannot be overwritten
    final var isAlive: Bool {
        return self.death == nil
    }

    init(birth: Date) {
        self.birth = birth
    }

    var description: String {
        return "I am a living thing that was born \(self.birth)"
    }
}
```

Inheritance (Cont'd)

```swift
// subclasses and superclasses

class Person : LivingThing {
    let firstName: String
    let lastName: String

    var fullName: String {
        return "\(self.firstName) \(self.lastName)"
    }

    // required - the subclass needs to implement the constructor
    required init(firstName: String, lastName:String, birth: Date) {
        self.firstName = firstName
        self.lastName = lastName
        // super can be used to call methods, properties and subscripts
        super.init(birth:birth)
    }

    func sayHello() -> String {
        return "Hello"
    }
}
```

Inheritance (Cont'd)

```swift
// subclass

class Student : Person {
    // Compile error because it's required
    init {

    }

    override var description: String {
        return "A student at Kristiania with the name \(self.fullName)"
    }

    override func sayHello() -> String {
        return "Halla \(firstName)"
    }

    // Compile error
    override var isAlive: Bool {
        return true
    }
}

var student = Student(firstName: "John", lastName: "Doe", birth: Date())
student.firstName // John
student.description // A student at Kristiania with the name John

student.birth
```

ARC

- Usually, ARC automatically handles memory for you, but sometimes you have to do a bit yourself
- Implicit strong reference
- Anything that has a reference is kept in memory

Optional Chaining

```swift
if let street = kristiania.students.first?.address?.street {
    print("the student lives on \(street).")
} else {
    print("Couldn't get the street name")
}
```

You can
- Access properties
- Call methods
- Call subscripts

Type Casting

is

— Used to check the type of an instance

as

— Used to treat an instance as if it were another type in its type tree

Type Casting (Cont'd)

```
class LivingThing {}
class Person: LivingThing {}
class Animal: LivingThing {}

let living = [
    Person(birth: NSDate()),
    Animal(birth: NSDate()),
    Person(birth: NSDate()),
    Animal(birth: NSDate()),
    Animal(birth: NSDate())
]

living[0] is Person // true
living[1] is Animal // true
living[2] is Animal // false
```

as?

```swift
for item in living {
    if let person = item as? Person {
        print("Is alive: \(person.isAlive)")
    } else if let animal = item as? Animal {
        print("\(animal.roar())")
    }
}
```

Any & AnyObject

- AnyObject can represent an instance of any class type
- Any can represent an instance of any type, including feature types
- Should only be used when you actually need it, be explicit

Any & AnyObject (Cont'd)

```swift
let someObjects: [AnyObject] = [
    Person(birth: NSDate()),
    Person(birth: NSDate()),
    Dog(birth: NSDate())
]

for object in someObjects {
    switch object {
    case let person as Person:
        print("Is alive: \(person.isAlive)")
    default:
        print("Not a person.")
    }
}
```

Any & AnyObject (Cont'd)

```
var things = [Any]()

things.append(0)
things.append(42)
things.append(3.14159)
things.append("hello")
things.append((3.0, 5.0))

for thing in things {
    switch thing {
    case 0 as Int:
        print("It was an int which was 0")
    case let someInt as Int:
        print("Found and Int that is: \(someInt)")
    case let someDouble as Double where someDouble > 0:
        print("A positive Double \(someDouble)")
    case is Double:
        print("Found some Double")
    case let someString as String:
        print("Found a string containing \"\(someString)\"")
    case let (x, y) as (Double, Double):
        print("a (x, y) with the values x: \(x), y: \(y)")
    default:
        print("Something else")
    }
}
```

Guard

```swift
let rocketDictionary : [String : String]? = [ "name" : "Falcon 9", "fuelName" : "liquid oxygen" ]

var factoryRobotsReady = true

func generateRocket(rocketDictionary: [String : String]?) {
    if factoryRobotsReady {
        if let actualDictionary = rocketDictionary {
            if let rocketName = actualDictionary["name"] {
                if let fuelName = actualDictionary["fuelName"] {
                    Rocket(rocketName, fuelName: fuelName)
                }
            }
        }
    }
}
```

Guard (Cont'd)

```swift
func generateRocketSchematics(rocketDictionary : [String : String]?) {
    guard factoryRobotsReady else {
        print("robots not ready")
        return
    }

    guard let actualDictionary = rocketDictionary else {
        print("no data to generate schematics")
        return
    }

    guard let rocketName = actualDictionary["name"] else {
        print("no rocket name")
        return
    }

    guard let fuelName = actualDictionary["fuelName"] else {
        print("no fuel name")
        return
    }

    Rocket(rocketName, fuelName: fuelName)
}
```

Extensions

- Extend functionality for a specific type
- Normal and static computed properties
- Define new instance methods and class methods
- New init methods
- New subscripts
- Define a new nested type
- Allows you to implement a protocol for an existing type

Extensions (Cont'd)

```swift
extension String {
  var uppercase: String { return self.uppercaseString }
}

var name = "John Doe"
name.uppercase // "JOHN DOE"
```

Protocols

- Similar to an interface in Java and other languages
- Defines a set of methods, properties, class methods, operators, and subscripts that fit a particular functionality
- Contains no implementation code

Protocols (Cont'd)

```swift
protocol LivingThing {
  var mustBeSettable: Int { get set }
  var doesNotNeedToBeSettable: Int { get }


  static func someTypeMethod()
  func random() -> Double
  mutating func toggle() // Makes it possible to change properties
}
```

Protocols (Cont'd)

- A protocol can be used anywhere that a type could be used
- A class, struct, or enum can implement multiple protocols
- Protocols can inherit from each other
- More about protocols when we switch to iOS

Protocols (Cont'd)

— We can make a type conform to our protocol with an extension

```
struct Newbie {
}

protocol ValorantPlayer {
    func chat() -> String
}

extension Newbie: ValorantPlayer {
    func chat() -> String {
        return "rAzE iS oP!"
    }
}
```

Protocol extensions

- We can create default implementations for methods
- Apple encourages Protocol oriented development

```
extension LivingThing {
    func random() -> Double {
        return 42
    }
}
```

Generics

- A lot of Swift's standard library is built with generic code
- Allows writing flexible code that can be used with different types
- For example: Array and Dictionary are of the generic collections type

Generic functions

```
func printSequence<T: Sequence>(sequence: T) {
    for part in sequence {
        print(part)
    }
}

printSequence(sequence: "ABCDEF")
printSequence(sequence: ["Aa", "Bb"])
printSequence(sequence: ["A": "B", "B": "A"])
```

Generic Types

- Enums, structs, and classes can also be generic
- The Array and Dictionary are examples of generic structs

Generic Classes

```
class GenericClass<T> {
    var object: T

    init(object: T) {
        self.object = object
    }

    func getObject() -> T {
        return self.object;
    }

    func prinObject() {
        print("Type of T is \(self.object)");
    }
}

var a = GenericClass<Int>(object: 1)
a.prinObject()
```

Associated Types

- In a protocol one can create an alias (associated type) where it is up to the implementation to define the actual type
- You can refer to the type in methods and subscripts without determining the type in the protocol

Associated Types (Cont'd)

```swift
protocol Container {
    associatedtype ItemType
    mutating func append(item: ItemType)
    var count: Int { get }
    subscript(i: Int) -> ItemType { get }
}

class Example: Container {
    typealias ItemType = String
    var array = [ItemType]()

    func append(item: ItemType) {
        self.array.append(item)
    }

    var count: Int {
        get {
            return array.count
            }
    }

    subscript(i: Int) -> ItemType {
        get {
            return array[i]
        }
    }
}
```

Operator overloading

```
func +(left: Balloon, right: Balloon) -> [Balloon] {
    return [left, right]
}

let balloon1 = Balloon()
let balloon2 = Balloon()

let array = balloon1 + balloon2
```

Further reading

— See the TSPL book on the main topics of the lecture

The rest is not required for the course. Just for the exercises.

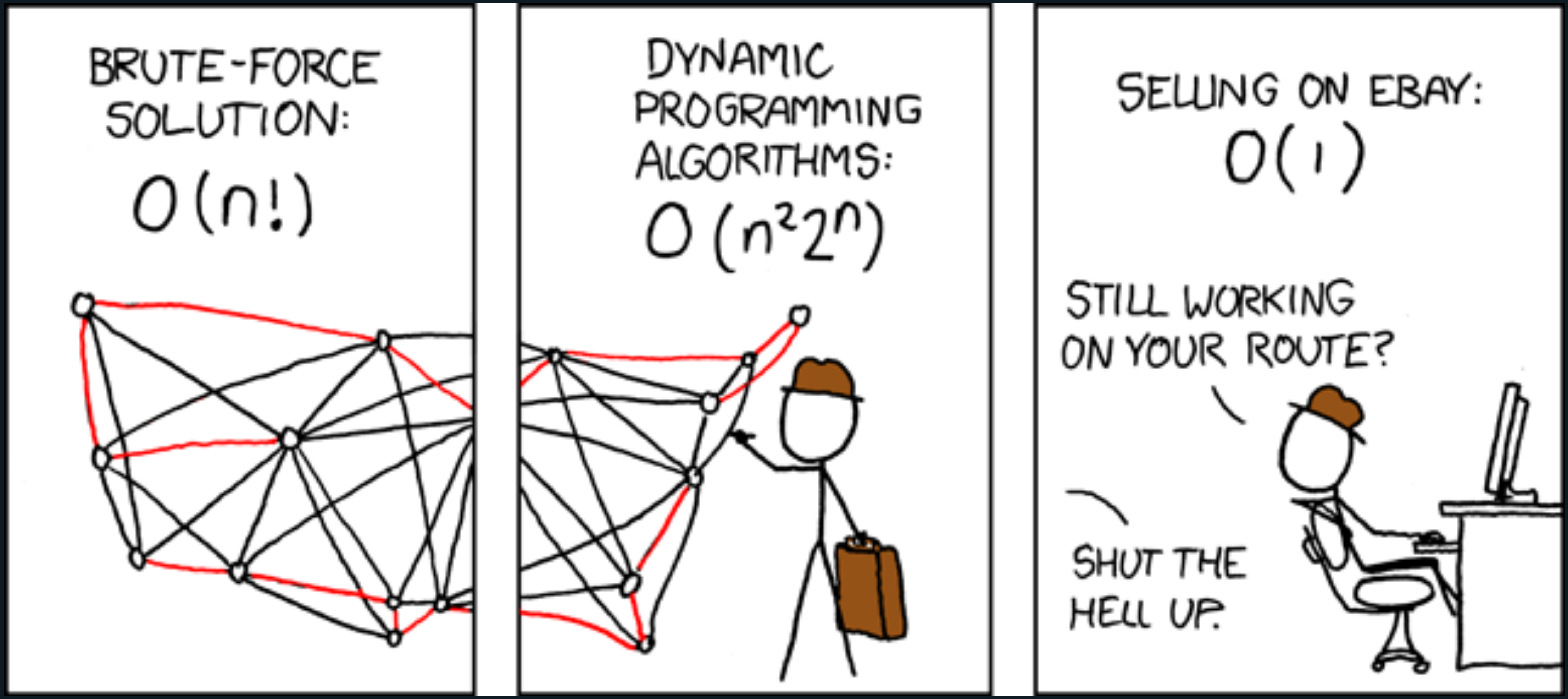
TSP

TSP (Travelling salesman problem) is a classic.

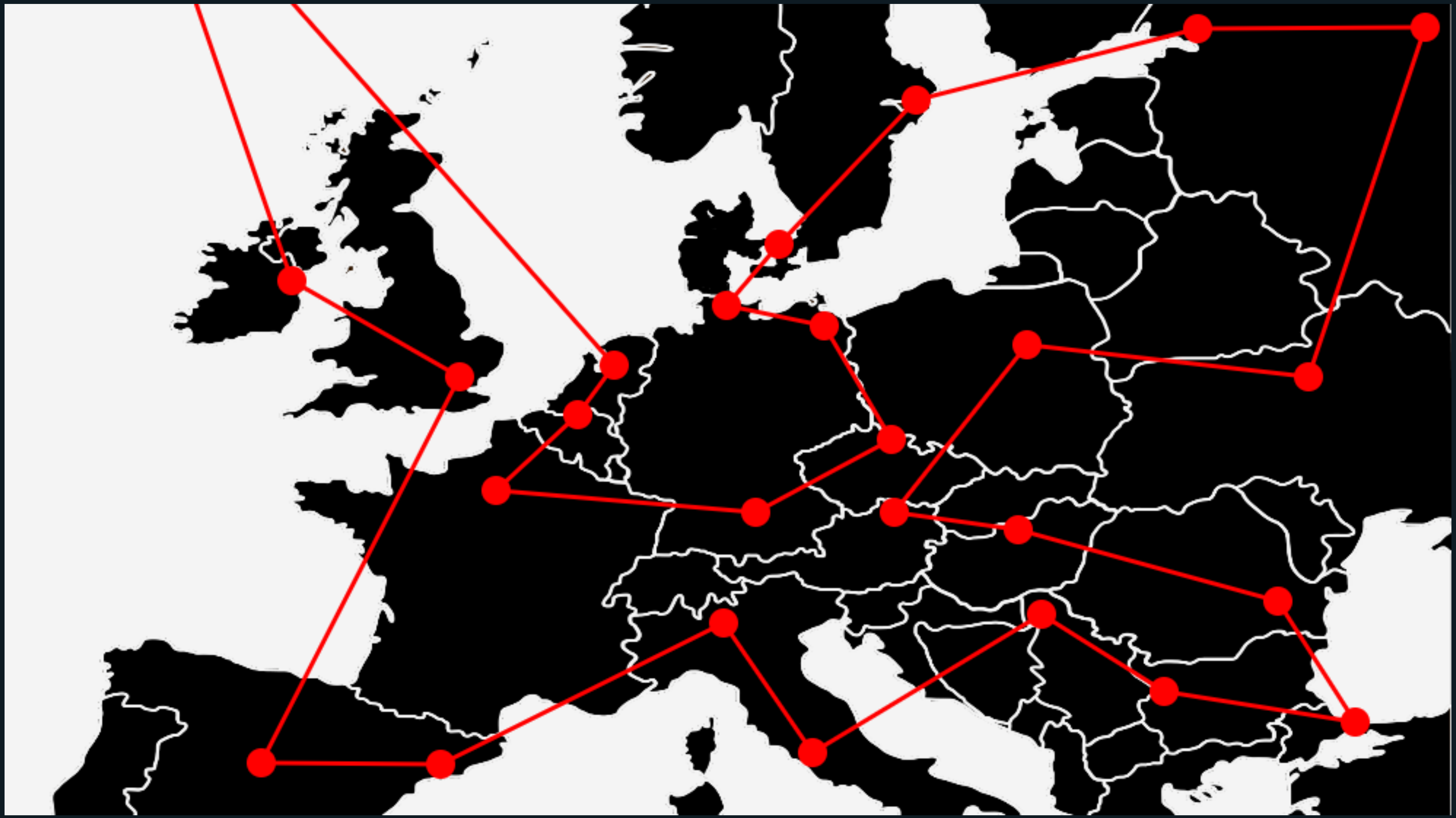
Complexity: O(n!) 😱

Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city and returns to the origin city?

TSP (Cont'd)


BRUTE-FORCE SOLUTION:
O(n!)
DYNAMIC PROGRAMMING ALGORITHMS:
O(n²2ⁿ)
SELLING ON EBAY:
O(1)
STILL WORKING ON YOUR ROUTE?
SHUT THE HELL UP.

TSP (Cont'd)



TSP (Cont'd)

Rock band tour problem

A rockband wants to calculate the optimal route between cities.

TSP (Cont'd)

Australia: 7! = 5,050 possible routes

1.4 hours (we can do the concert)

TSP (Cont'd)

Australia: 7! = 5,050 possible routes
1.4 hours (we can do the concert)

USA: 22! = 1,124,000,727,777,607,680,000 = 1.1×10^{21}
3.6 years! (we need to plan ahead)

TSP (Cont'd)

Australia: 7! = 5,050 possible routes
1.4 hours (we can do the concert)

USA: 22! = 1,124,000,727,777,607,680,000 = 1.1×10^{21}
3.6 years! (we need to plan ahead)

India: 29! = 8.8×10^{30}
2×10^{11} years! (no tour in India)

TSP (Cont'd)

Australia: 7! = 5,050 possible routes
1.4 hours (we can do the concert)

USA: 22! = 1,124,000,727,777,607,680,000 = 1.1×10^{21}
3.6 years! (we need to plan ahead)

India: 29! = 8.8×10^{30}
2×10^{11} years! (no tour in India)

World: 100! = 9.3×10^{157}
3×10^{138} years! (forget it!!!)

TSP (Cont'd)

Possible solution?

Use a heuristic for a "good" solution, not necessarily the best, but it's good enough.

Nearest Neighbour Algorithm

Greedy Algorithm: is an algorithmic paradigm that follows the problem solving heuristic of making the locally optimal choice at each stage with the intent of finding a global optimum

Nearest Neighbour Algorithm (Cont'd)

Given a list of points [k], and a starting point x

- From x, find the closest point in [k]. Let's call this point y
- Remove y from [k]
- Add y to a queue
- y is the new x
- Repeat untill [k] is empty

Tasks

See Exercises on GitHub