# 2020 CI401 Introduction to programming

# Week 1.06 Let's play Top Trumps!

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Module leader

10<sup>th</sup> November 2020

### Lecture recording and attendance

- This lecture will be recorded and published in the module area
- The focus of recording is on the lecturer, not the audience
- If you are particularly concerned not to be part of the recording, turn off your microphone and camera.
- In addition, lecture attendance is now being routinely recorded (in all modules) to help the School Office monitor engagement

 (This slide is really a reminder to me to start recording and record attendance!)

### Code clinic

- If you need help with programming or databases then our Code Clinic sessions may be the answer. Every weekday in semester 1 we are running 1 hour sessions to help Level 4 and Level 5 students with their programming and databases work.
- The sessions are run by final year computing students and take place on Microsoft Teams. The join code is o727xhp
- Sessions:
  - Mon-Wed, 1pm-2pm
  - Thu, 12pm-1pm

# Data - representing information in computers

#### Data

- We're all used to the idea of data as information processed by computers
- It might be information about us, or the world, shopping, travel etc.
- So far, the only data we have seen in our programs is a few strings (countries, rooms, names etc.) and numbers (sizes, prices, ages etc.)
- And the only way we have organised this data has been as individual items or arrays holding lists of items
- Now we need to get a bit more serious about data!

### Data comes in many forms

- If we use a cash machine, the system accesses information about our bank account to make sure we have enough money to draw out, or to deposit money to the right place
- If we play a game like Football Manager, the system has lots of knowledge about teams and players, and also how to play football matches
- If we play an adventure or action game, the system has knowledge about the world, characters and objects, storylines and goals and also 'how the world works' – gravity, collisions, damage etc.
- \*But how is this actually achieved in a computer

- Top Trumps is a card game
- A pack of cards has a theme, such as Harry Potter wizards
- Each card represents a wizard, and has key facts and figures about that wizard (such as: first year at Hogwarts, wand length, family tree, fear factor, top trumps rating)
- The game is played by one player selecting a card and a fact category (eg wand length), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and "then you do it again, until one player has won all the

- Top Trumps is a card game
- A pack of cards has a theme, such as football players
- Each card represents a footballer, and has key facts and figures about that footballer (such as: age, goals scored, shooting power, sprint speed)
- The game is played by one player selecting a card and a fact category (eg goals scored), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as dinosaurs
- Each card represents a dinosaur, and has key facts and figures about that dinosaur (such as: size, ferocity, how long ago it lived, how many fossils have been found)
- The game is played by one player selecting a card and a fact category (eg ferocity), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as superheroes
- Each card represents a superhero, and has key facts and figures about that superhero (such as: strength, stamina, speed, number of companions)
- The game is played by one player selecting a card and a fact category (eg stamina), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as cities
- Each card represents a city, and has key facts and figures about that city (such as: size, population, rental prices, crime rate, number of schools)
- The game is played by one player selecting a card and a fact category (eg rental prices), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as bank accounts
- Each card represents a bank account, and has key facts and figures about that account (such as: balance, overdraft limit, number of transactions, name, address)
- The game is played by one player selecting a card and a fact category (eg balance), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as students
- Each card represents a student, and has key facts and figures about that student (such as: firstname, surname, gender, age, course)
- The game is played by one player selecting a card and a fact category (eg age), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

- Top Trumps is a card game
- A pack of cards has a theme, such as pop-up windows
- Each card represents a pop-up window, and has key facts and figures about that window (such as: size, position on screen, message, response)
- The game is played by one player selecting a card and a fact category (eg size), and other players have to select a card that they hope will beat everyone else in that category. If so, they win all the cards played, and then you do it again, until one player has won all the cards.

### Top Trumps cards and 'things'

- In Top Trumps the cards represent actual things in the real (or imaginary) world
- Each card contains limited information about the thing it represents – just enough to make the game fun to play if you are interested in the theme.
- The game itself knows nothing about the theme you play it the same way regardless of the particular theme/world. (But the theme adds a lot to our enjoyment of the game.)
- Computers represent information like Top Trump cards

### Computer data and 'things'

- In computers data items represent actual things in the real (or imaginary) world
- Each data item contains limited information about the thing it represents – just enough to achieve the goal of the program that uses it
- The program itself knows nothing about the actual things it has no 'real world knowledge'
- For example, it won't know that two people with the same parents are siblings, or that penguins can't fly – unless that information is provided to it

### Java objects and 'things'

- In Java, we call the data items that represent actual things objects
- This is dangerously confusing, because they really are not physical objects in any sense, just as a Top Trumps card is not an actual superhero
- Objects in Java (and other object-oriented programming languages), are little packages of information in the computer memory which our programs make and use to achieve some goal
- A Java object is like a Top Trumps card, with information written on it about a 'thing', which we call the object's state
- A Java object also has the ability to do things, and change its state, which we call its behaviour – we will talk more about that next week.

firstName	David
surname	Smith
gender	male
age	19
course	CS

firstName	Jane
surname	French
gender	female
age	18
course	SE

firstName	Robyn
surname	Jones
gender	female
age	18
course	CS-AI

firstname	Mark
surname	Jones
gender	male
age	18
course	CSG

firstName	Mollie
surname	Daniels
gender	female
age	25
course	CS

firstName	Aaron
surname	Kingston
gender	male
age	29
course	WMC

firstName	David
surname	Smith
gender	male
age	19
course	CS

firstName	Jane
surname	French
gender	female
age	18
course	SE

This is like a deck of Top Trump cards

– they all have the same pattern, but
it doesn't matter (to the computer)
what it is and it doesn't really
'understand' them

C2-AI

course

firstName	Mark
surname	Jones
gender	male
age	18
course	CSG

firstName	Mollie
surname	Daniels
gender	female
age	25
course	CS

firstName	Aaron
surname	Kingston
gender	male
age	29
course	WMC

firstName	David
surname	Smith
gender	male
age	19
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C2-AI

firstname	Mark
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course	CSG

firstName	Mollie
surname	Daniels
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age	25
course	CS

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course

In Top Trumps, all the values are numbers, so that you can play the game. In programming, we're usually not actually playing Top Trumps, so we can have non-numeric values, like names.

# Example: representing Bank Accounts

firstName	David
surname	Smith
balance	£20
overdraftLimit	£100

firstName	Jane
surname	French
balance	-£50
overdraftLimit	£100

firstName	Mark
surname	Jones
balance	£500
overdraftLimit	£100

firstName	Mollie
surname	Daniels
balance	£5000
overdraftLimit	£1000

This is a different deck, with a different pattern of facts – as long as the pattern is the same within the deck, that's fine

### Managing decks of cards

- Each deck of cards has a particular pattern, and the computer needs to know this, to know how to use the cards, and also how to make new cards in that deck.
- So it needs a template for making cards for each deck how to make orange one (students), or green ones (bank accounts etc.).
- In fact, almost all of Java programming is writing these templates

   the program itself makes the cards when it runs, and then uses
   them.
- We have talked briefly about these templates and cards already in Java terminology, the templates are Classes, and the cards are Objects

String firstName	
String surname	
String gender	
int age	18
String course	CS

			firstName	Robyn
		firstName	Jane	Jones
		surname	French	female
firstName	Da	avid	female	18
surname	Sr	nith	18	CS-AI
gender	m	ale	SE	
age	19	)		
course	CS	5	firstName	Aaron
		Carthian	surname	Kingston
		firstName		•
		111001101110	Mollie	male
firstName	М	ark	Daniels	male
firstName surname				29
	Jo	ark	Daniels	
surname	Jo	ark nes ale	Daniels female	29

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String firstName	
String surname	
String gender	
int age	18
String course	CS

	firstName
	surname
firstName	David
surname	Smith
gender	male
age	19
course	CS

firstName

Mark

Jones

male

18

French	female
female	18
18	CS-AI
SE	
firstName	Aaron
surname Mollie	Kingston
Daniels	male
fomalo	29

Robyn

Jones

WMC.

firstName

Jane

female

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CS

This is a pattern for making cards. It has the name of each category, and also the Java type of the value. (It can also have an initial value – does this sound familiar from last week? The categories are a kind of variable, called object or instance variables.)

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# Example: representing Bank Accounts

String firstName	
String surname	
double balance	0.00
double overdraftLimit	0.00

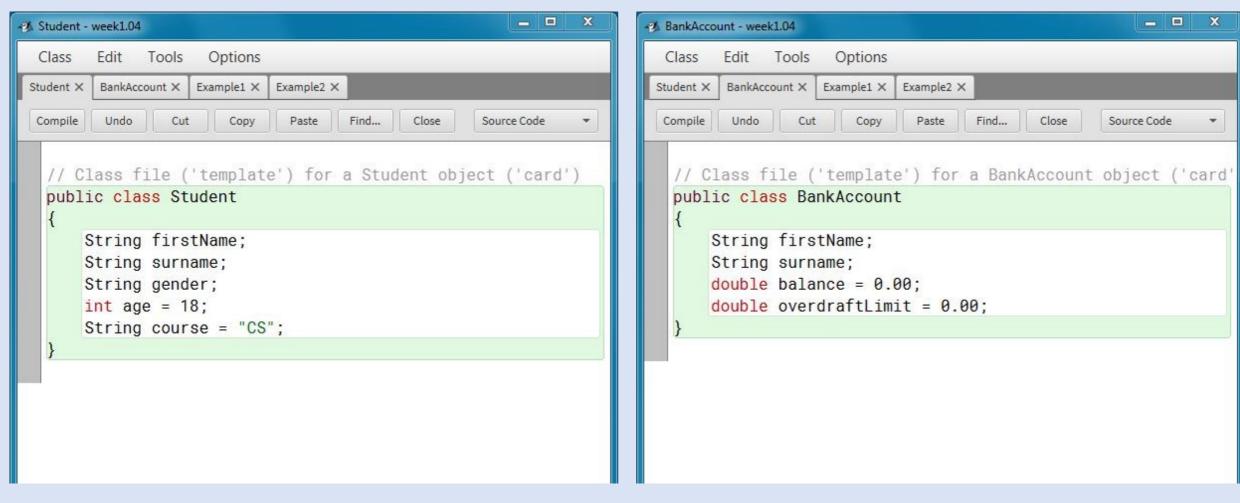
firstName	David
surname	Smith
balance	£20
overdraftLimit	£100

firstName	Mark
surname	Jones
balance	£500
overdraftLimit	£100

firstName	Jane
surname	French
balance	-£50
overdraftLimit	£100

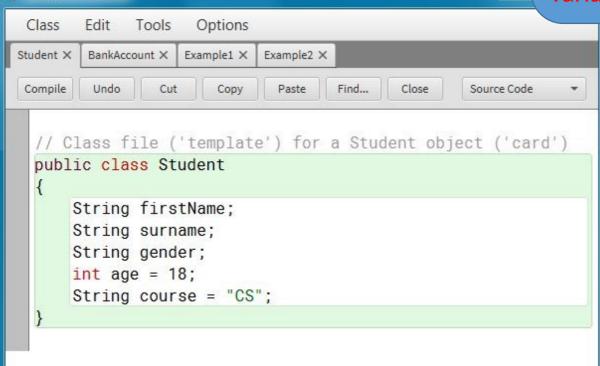
firstName	Mollie
surname	Daniels
balance	£5000
overdraftLimit	£1000

### Java classes



#### Java classes

We 'declare' the class and give it a name (starting with a capital letter). The definition of the class is in its 'body' (inside the curly brackets). In these examples, we use standard variable declarations for each of the instance variables of an object (ie the key facts on a card in this deck)



```
BankAccount X Example1 X
                             Example2 X
Student X
Compile
        Undo
                 Cut
                       Copy
                                              Close
                               Paste
                                       Find...
                                                       Source Code
  // Class file ('template') for a BankAccount object ('card'
 public class BankAccount
      String firstName;
      String surname;
      double balance = 0.00;
      double overdraftLimit = 0.00;
```

Student - week1.04

### Classes and objects

- Classes like these are templates to make objects
- They are not the objects themselves
- They are like a pattern to print new Top Trumps cards you can only play Top Trumps if you have printed out some cards
- When you have a class definition, you can use it to create objects using the keyword new, like this:

```
Student myStudent = new Student();
```

 This can only happen as a program runs – the program itself is just a set of class definitions

### Creating objects

Let's look closely at the Java code for making a new object:

```
Student myStudent = new Student();
```

- This uses the class Student to make a Student object, and store it in a variable called myStudent
- So this is a variable declaration/initialisation statement where
  - The variable type is Student (classes are also types)
  - The phrase 'new Student()' is an expression which returns a Student object
- A second declaration would create a separate Student object (with its own name, age, course etc):

```
Student anotherStudent = new Student();
```

#### Classes we have seen

- We have seen examples of classes already both String and Scanner are classes which are part of Java itself
- Remember that we had to make a Scanner object before we could use the library? – classes themselves are just templates

```
Scanner myScanner = new Scanner (System.in);
```

- And Strings are special. You can say new String(), but using " ... " is a shortcut for doing the same thing.
- In addition all our Examples and Labs are classes notice that a class lives in a file with the same name – Example1.java, FortuneTeller.java

### Classes and programs

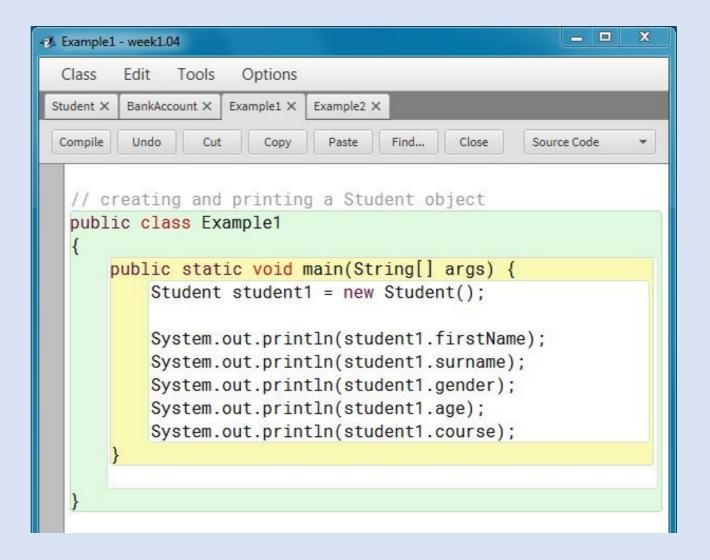
- A program is just a set of class definitions
- But our example classes, Student and BankAccount don't have very much code in them – just a few variable declarations
- Next week we will see how to put more interesting code into a class
- But for now, we will just notice that we have been putting code inside classes all along – using a rather mysterious piece of Java code:

```
public static void main(String args[]) { ... };
```

• This is called a main method – a class with this in it can run as a program, and when it does, the code in the body { ... } is what runs

Here is an example program which uses two classes

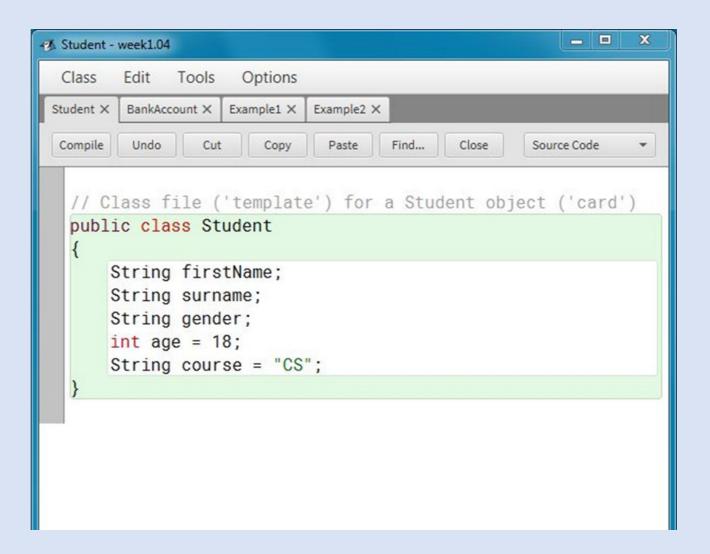
One is the class Example1 - the program itself (with a main method)



Here is an example program which uses two classes

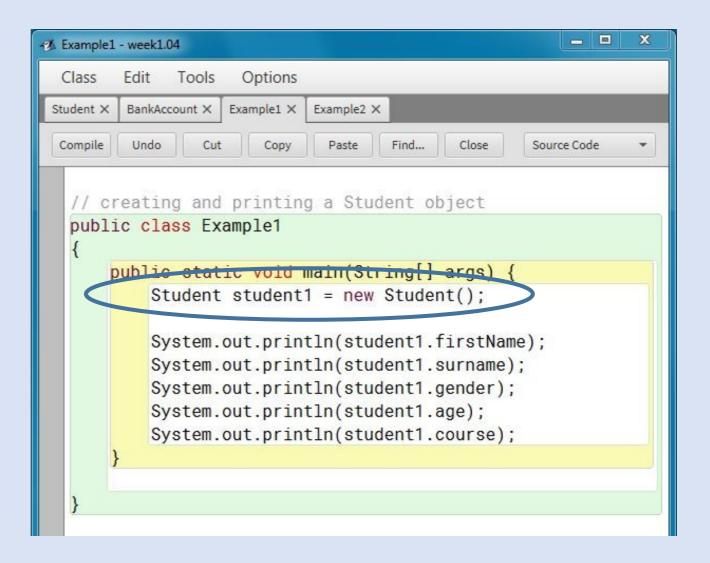
One is the class Example1 - the program itself (with a main method)

The other is the class Student, which the program uses



The first thing that happens in our program is that we make a Student object, and put it in a variable called student1

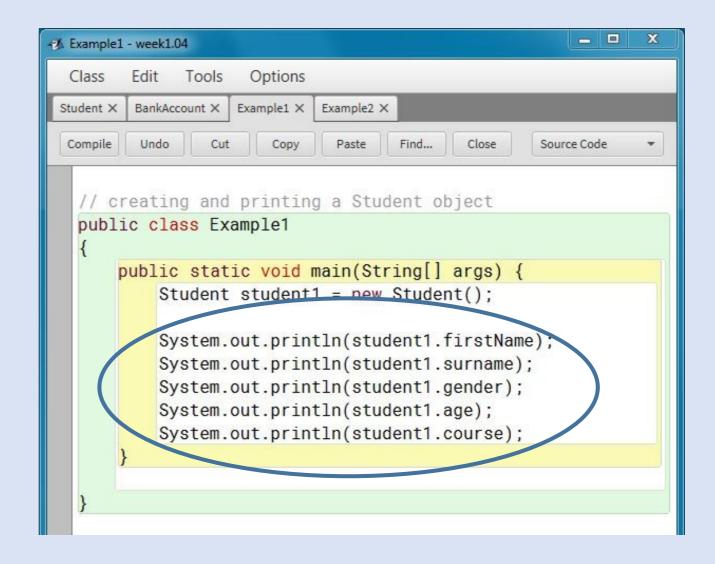
This is like creating a new card in the Student deck



Here we are printing out all the information we have about student1.

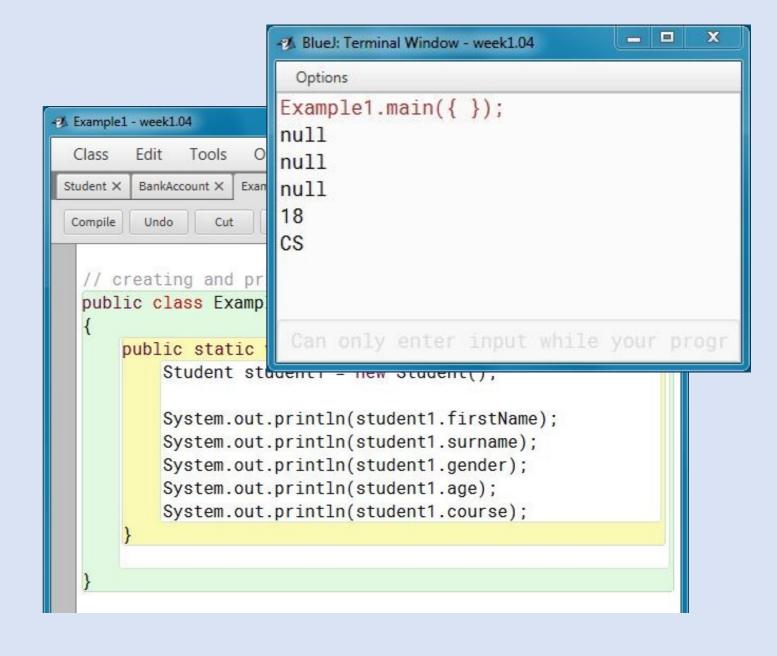
Notice the way we use the period here:

student1.firstName gets us the firstName value from the card contained in student1



Here's the output when the program runs

Notice that because we didn't initialise firstName, surname and gender, they are set to null – the special value meaning 'nothing' or 'undefined'.



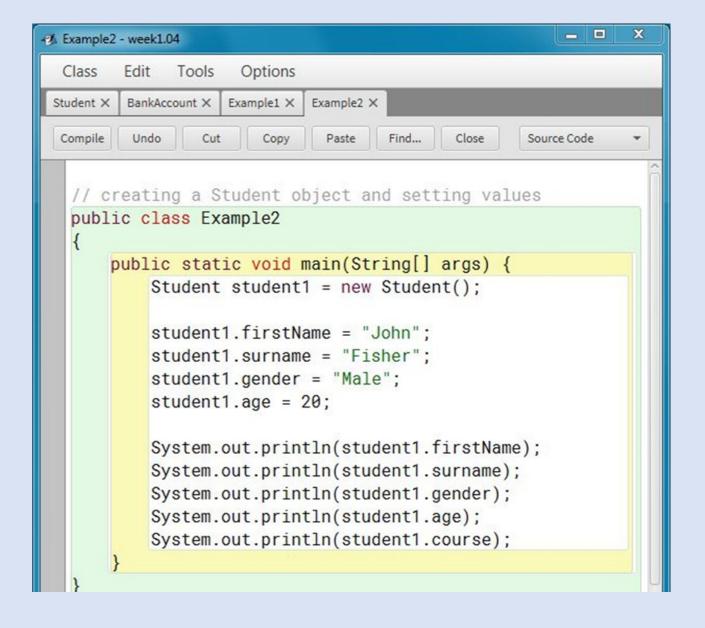
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Example2 is another program using Student

Remember we said that firstName, surname etc are called instance variables

This means they are variables inside the instance (object)

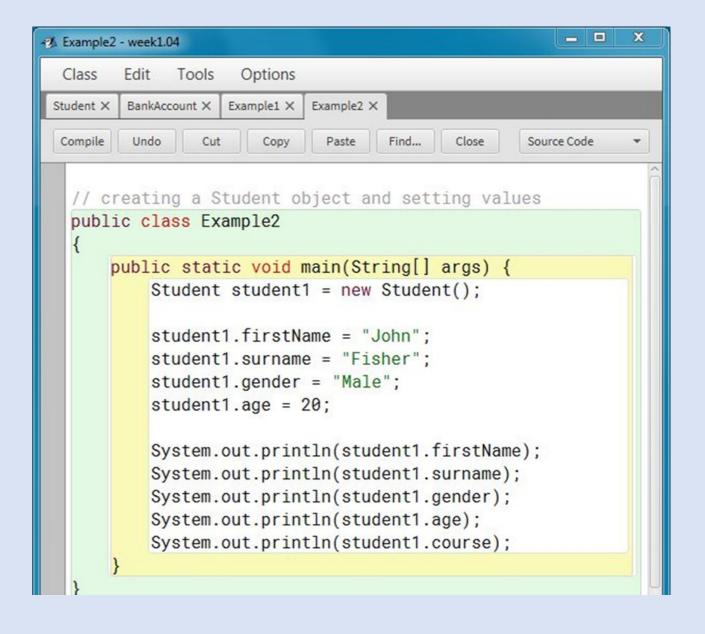
You can use them just like other variables by adding the object's name and a period to the front



In Example2 we assign values to the variables for student1 ourselves

These replace the values that were provided when we made the object

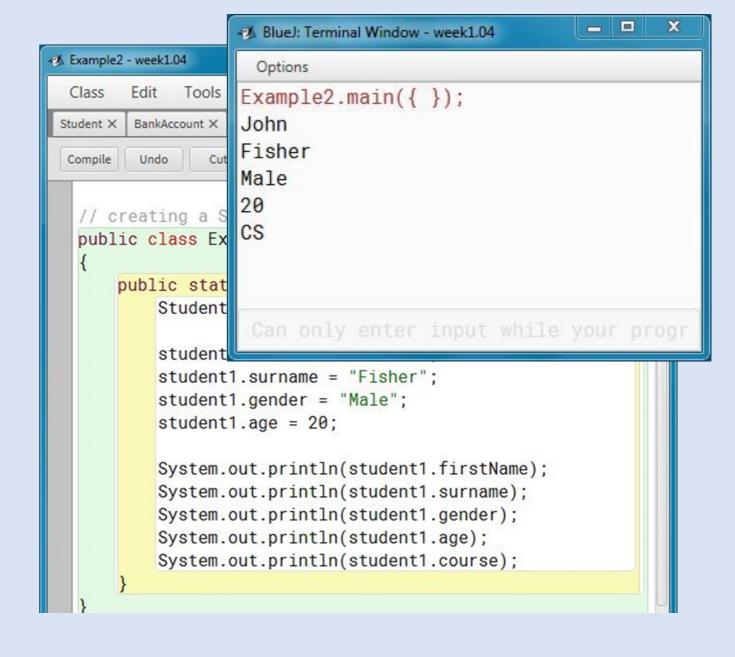
We print them out just to be sure it worked



In Example2 we assign values to the variables for student1 ourselves

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We print them out just to be sure it worked



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### Discussion

### Data in computers

- Computers represent data just like Top Trumps cards
  - The information on a card is useful for the particular game, but not much else
  - The information in a computer is enough for a particular programming task, but not much else
- In Java we call the 'cards' objects, and we create classes which are templates for making new 'decks of cards'
- Computers have no 'real world knowledge' just what is on the cards

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But they have lots of cards!

#### Data and AI

- In traditional programming, the programmer has to design all the cards, and how they interact – so they generally make some kind of sense
- In modern 'AI', we use machine learning which really means the computer is designing cards itself, based on patterns of data
- When it does this, the cards may not make sense (to us), which is why modern 'algorithms' get a bad press for making decisions we don't understand

### Computers and humans

- We asked the question 'Are computers just playing Top Trumps?'
- The answer seems to be 'Yes', at least from a data perspective.
- But they are very good at it!
- The real question, though, is 'Are WE just playing Top Trumps?'
- (If not, what are we doing that's different?)

• This is the key question behind GOFAI ('Good old-

# Lab exercises Week 1.06

### Lab exercises 1.06

- Lab1 Extending the Student example a bit more, including making an array of student objects
- Lab2 Modifying the Student example to be a simple version of the Top Trumps game
- The BankAccount class is also there, in case you want to play with that as well.