Cognitive Modelling

Modelling of face perception 1

Introduction

- Fourth module of the course: application of methods and theories seen so far.

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- You'll run an experiment based on face perception and model the data you collect.

The experiment

- Cognitive test about face perception
  - How do we recognize that a face is smiling?
  - What characterizes a masculine-looking vs a feminine-looking face?

Can we teach a computer to model this kind of information?

The experiment

- The experiment we are going to work on is inspired by the following paper:

Fagertun, Jens, Tobias Andersen, and Rasmus Reinhold Paulsen. "Gender recognition using cognitive modeling." European Conference on Computer Vision. Springer, Berlin, Heidelberg, 2012

Available on Inside.

Person perception vs face perception

- When interacting with other people, we subconsciously make all sort of determinations about them:
  - Are they friendly? Or angry?
  - Age
  - Gender
  - …
- These are based on many different types of data:
  - Looks
  - Voice
  - Clothes they are wearing

Person perception vs face perception

- In this experiment we limit ourselves to faces
- Our data are sets of portrait pictures of faces

Modelling of facial expressions

- Can be used as a way to model human emotions
- FACS (Facial Action Coding System) is a popular model, which was proposed in the late 1970 by Ekman, Friesen and others
- It's based on modelling small components of an expression (Action Units)
- Human coders initially. Now also machines.

Binary classification vs continuous scales

- The binary classification (friendly/not friendly, male/female) is not enough.
- Our brain is able to model in-betweens and edge cases.
- How to teach this to a computer?

- In the experiment, the test person will make binary classifications, and we want our model to be able to deal with the continuous.

How to? Let's try!

- Determine if the faces on the next slides are smiling. Quick! Don't overthink it ☺

What can we notice?

- Could we perform the task?

- How long did it take?

What can we notice?

- Could we perform the task?
  - Generally yes

- How long did it take?
  - The **edge/in-between cases** give a **slower** reaction

    We can build **reaction time** into our model

    This gives us a **continuous** scale, that encodes the perceived *strength* or *intensity* of the chosen variable in the stimulus.

The data

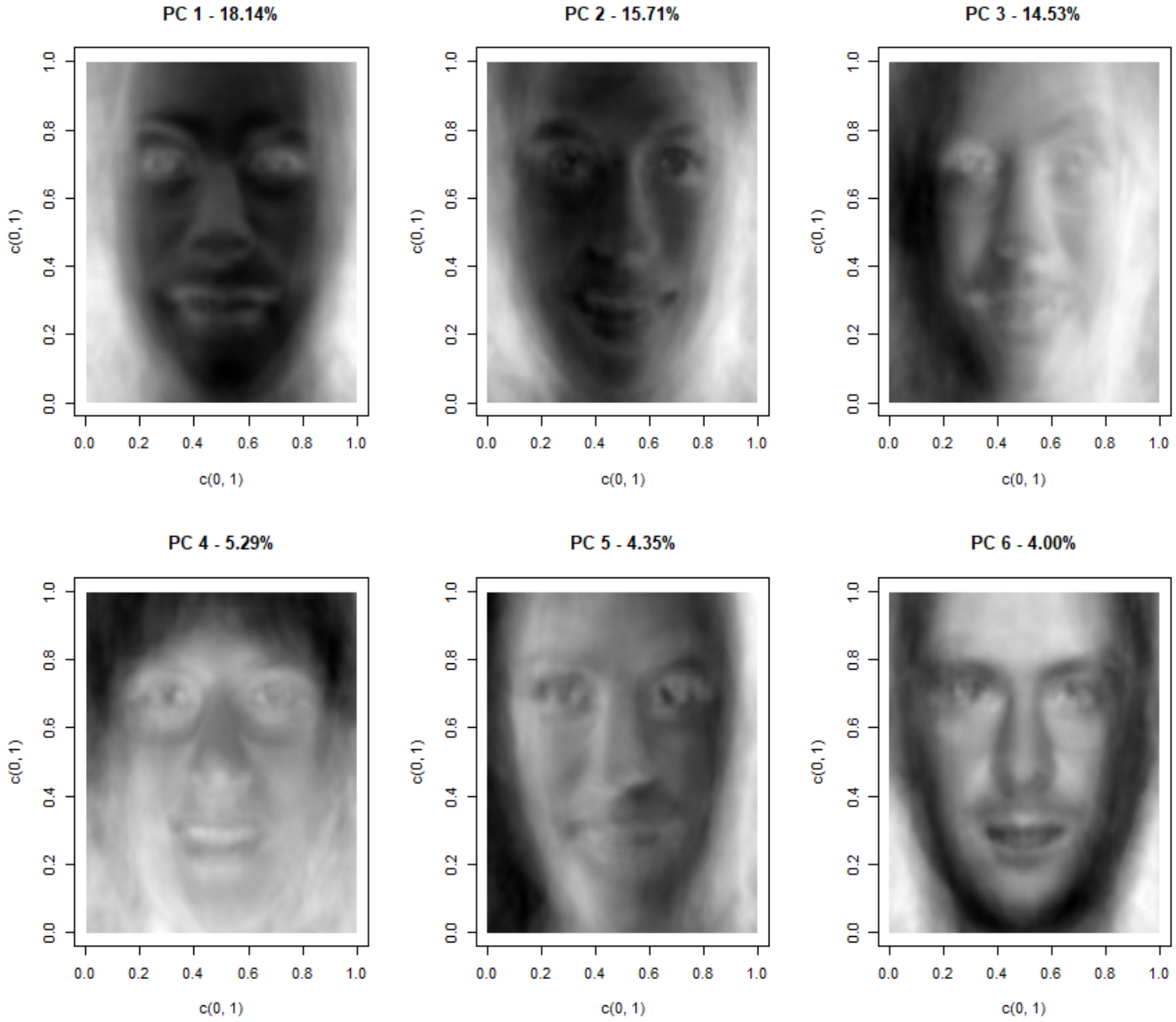
- We use publicly-available face databases
- Links are in the homework

- How to include picture data in our model?
  - A lot of pixels
  - High dimensional! 600 * 600 = 360000!
  - Is a single pixel an interesting feature to model a face anyway?

- We need better (and fewer) features.

PCA for dimensionality reduction

- Principal Component Analysis gives us a way to
  - Reduce dimensionality
  - Find directions in our dataset that express large amounts of variance.


PC 1 - 18.14%
PC 2 - 15.71%
PC 3 - 14.53%
PC 4 - 5.29%
PC 5 - 4.35%
PC 6 - 4.00%
c(0, 1)
0.0
0.2
0.4
0.6
0.8
1.0

PCA for dimensionality reduction

- How can we interpret the principal components?

- Which components are relevant for our model?

We'll discuss this next time

Homework

The description is on Inside.

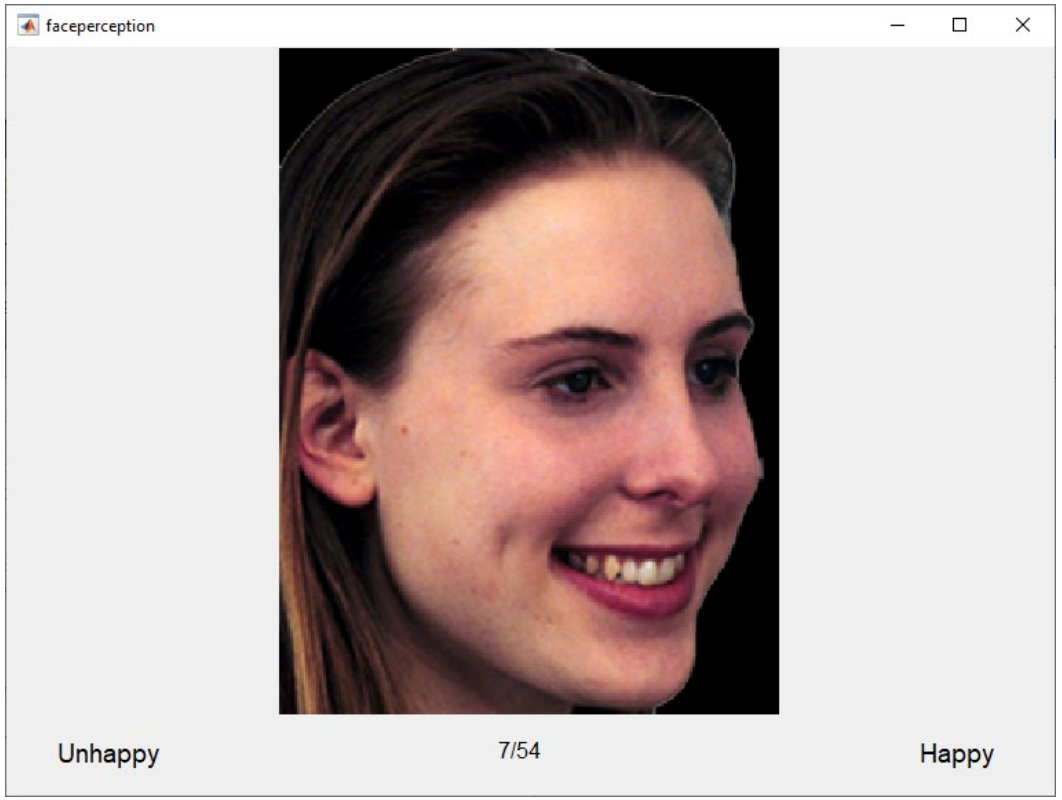
Goals:

1. Setup the experiment
2. Run the experiment
3. Analyze data
4. Build a model

The hand-in is a report covering the points above.

Run the experiment

A Matlab script to run the experiment is provided



Run the experiment

- It’s a very simplified stimulus presentation

- Some parameters need to be changed:

```
% BEGIN PARAMETERS
% enter the full path to your image database directory
image_folder = 'C:\Users\pamas\academia\teaching\2019E_cognitive_modelling\face_databases\KDEF-cropped\KDEF-cropped\';

% enter the file extension of your files
file_pattern = '*.png';

% enter the two options (left will correspond to the 'z' key, right to the
% 'm' key
handles.textLeft.String = 'Unhappy';
handles.textRight.String = 'Happy';
% END PARAMETERS
```

Run the experiment

- You'll have to enter a subject ID (integer)

- The sequence of pictures is randomized, with seed depending on the subject ID.

- During the experiment, use the keys **z** and **m** to answer the left and right option, respectively.

Test persons

- You'll use your group members as test persons. You are welcome to collect additional data from other people.

- The test person has to answer quickly. Aim at below one second. Not too much thinking ☺ Remember that we need the reaction times.

The collected data

- The Matlab script produces a file called “results.txt”, containing the collected answers.
- It’s a comma separated file with the following columns:

Subject ID	Trial number	Stimulus filename	Answer	Reaction time

Example

3	1	Photo3.jpg	Smiling	0.5
3	2	Photo1.jpg	Not Smiling	0.3

Goals for today

1. Choose a variable and a face database (links in the homework).

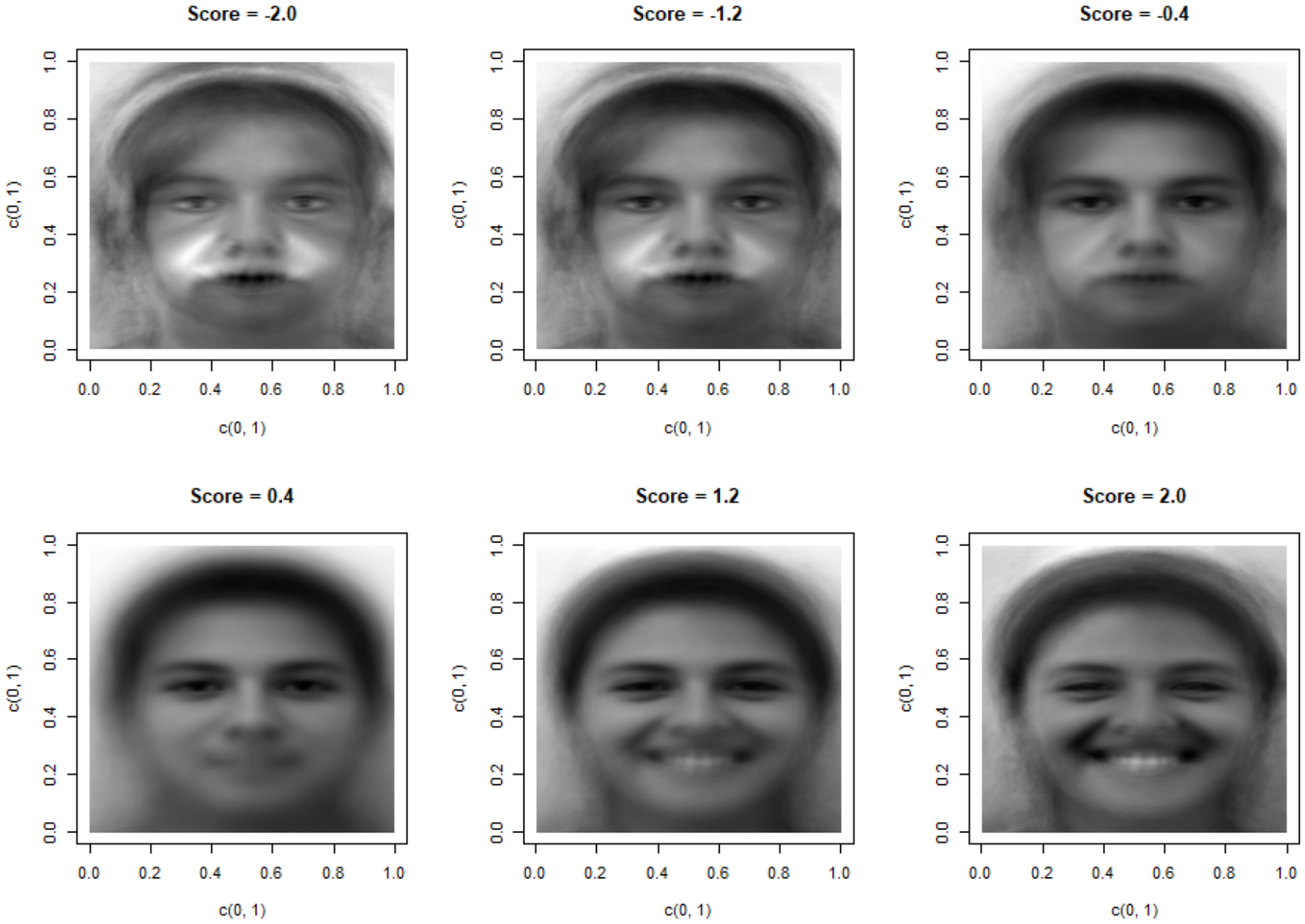
   The variable can be one of

   - smiling / not smiling
   - angry / not angry
   - masculine / feminine

2. Select a subset of pictures (~500) from the chosen database
3. Download the stimulus presentation script (Homework 4/Stimulus presentation script) from Inside
4. Set up the script with the chosen parameters and run pilot trials
5. Collect data using your group members as test subjects

Next week

- We'll focus on the modelling part of the project:
  - PCA
  - Feature selection
  - Generate new samples using the model


Score = -2.0
Score = -1.2
Score = -0.4
Score = 0.4
Score = 1.2
Score = 2.0
c(0, 1)
0.0
0.2
0.4
0.6
0.8
1.0