Homework 1

Two-dimensional convolution and checking results

Signal Processing (ECE-Y523) · University of Patras

Optional individual assignment · Handout

This assignment connects a calculation by hand with a Python implementation. We examine how input indices and boundaries affect convolution and how to choose data that help reveal an error. Finally, we design a small experiment on a topic covered in the course.

What you will do

Step	Activity
A	Calculate the full output shape and one convolution value, recording the individual products.
B	Complete the implementation, compare it with SciPy and design an additional test of your own.
C	Examine an incorrect implementation, explain your observations and correct the calculation.
D	Choose a question from the material of Lectures 1–3 and investigate it with a small Python experiment.

In step D, record your question and prediction, method and tools, code, result and interpretation. You may use libraries of your choice and AI tools. If you use AI, report the model and prompts. There is an optional feedback section at the end.

Before you start Work through the JupyterLab guide at `https://github.com/upatras-lar/jupyter-tutorial` (about 45 minutes): running cells, the order in which cells run, restarting the kernel and reading error messages.

Open `ECEUoP_SP_HW_1.ipynb` in Jupyter or VS Code with a Python kernel. You will need NumPy, SciPy and Matplotlib. If any are missing, run the following in a separate cell:

```
%pip install numpy scipy matplotlib
```

Then restart the kernel. The detailed questions and answer cells are in the notebook. Complete your code between the TODO comments and write your explanations in the corresponding cells.

What to submit One completed `.ipynb` file, with your full name and student ID in the identification cell at the beginning.

- Select **Restart Kernel and Run All**. Check that your code runs without errors.
- **Save with the outputs visible**, including the printed results and plots from step D. Executing the code and saving its outputs are part of the assessment.
- Keep the original `conv2d_candidate` as an example with incorrect results. Make the correction in C3. Code for a question that fails to run receives no credit for that question.

For revision: Lecture 3 slides and notes, Practice 3 (exercises 1.1, 1.2 and 5.1) and the worked exercises covered in the tutorials. For step D, you can also consult the corresponding material from Lectures 1–2.