Project 1

- Image Rotation

  Recall that transformation matrices can be used to rotate vectors. For example the rotation matrix will rotate a vector 45 degrees *Counter Clock Wise(CCW).* Points may be thought of as vectors from the origin, so we could equivalently say that it will rotate a point by 45 degrees *CCW* about the origin.

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} cos\theta & -sin\theta \\ sin\theta & cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \qquad A = \begin{bmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{bmatrix} = \begin{bmatrix} \cos(45°) & -\sin(45°) \\ \sin(45°) & \cos(45°) \end{bmatrix}$$

a. Rotate an image by 45 degrees as below example using forward method which calculates destination coordinates from original coordinates.

b. Rotate an image by 45 degrees as below example using backward method.

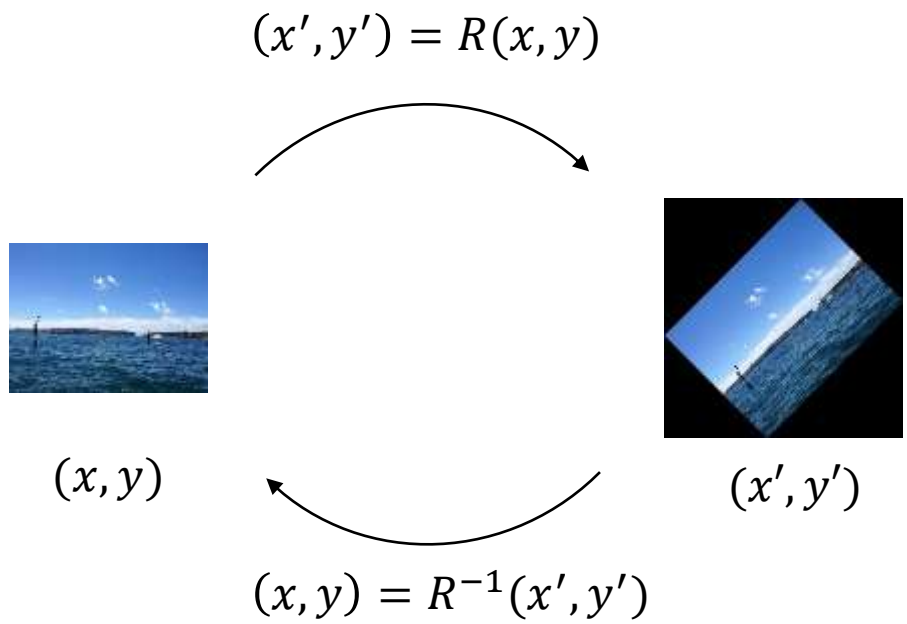
c. If you rounded coordinates on (b.), you used nearest neighbor interpolation method.
   Do rotate an image using bilinear interpolation method.
   (https://en.wikipedia.org/wiki/Bilinear_interpolation)

Input

Output

Computer Vision Programming Exercise 1

- Forward method: mapping with forward computation
  - For each (x, y), calculate (x', y') by $(x', y') = R(x, y)$
  - map $f(x, y)$ to $f(x', y')$
- Backward method: Mapping with backward computation
  - For each (x', y'), calculate (x, y) by $(x, y) = R^{-1}(x', y')$
  - map $f(x, y)$ to $f(x', y')$

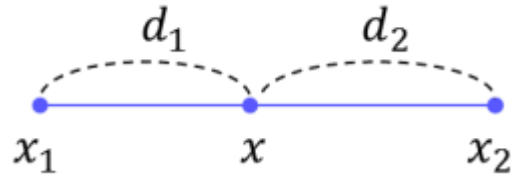


Computer Vision Programming Exercise 1

- Linear interpolation

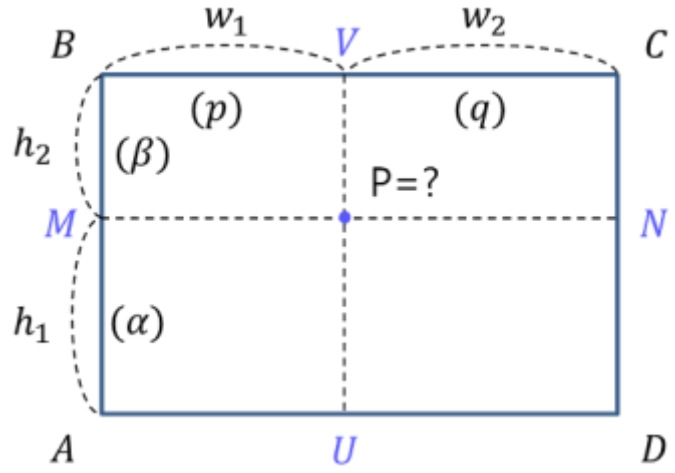
α = d1/(d1+d2), β = d2/(d1+d2)

$$f(x)=\beta f(x_1)+\alpha f(x_2)$$



- Bilinear interpolation

$$P=q(\beta A+\alpha B)+p(\beta D+\alpha C)$$
$$=q\beta A+q\alpha B+p\beta D+p\alpha C$$



How to do Exercise

1. Open the project file with Visual studio.

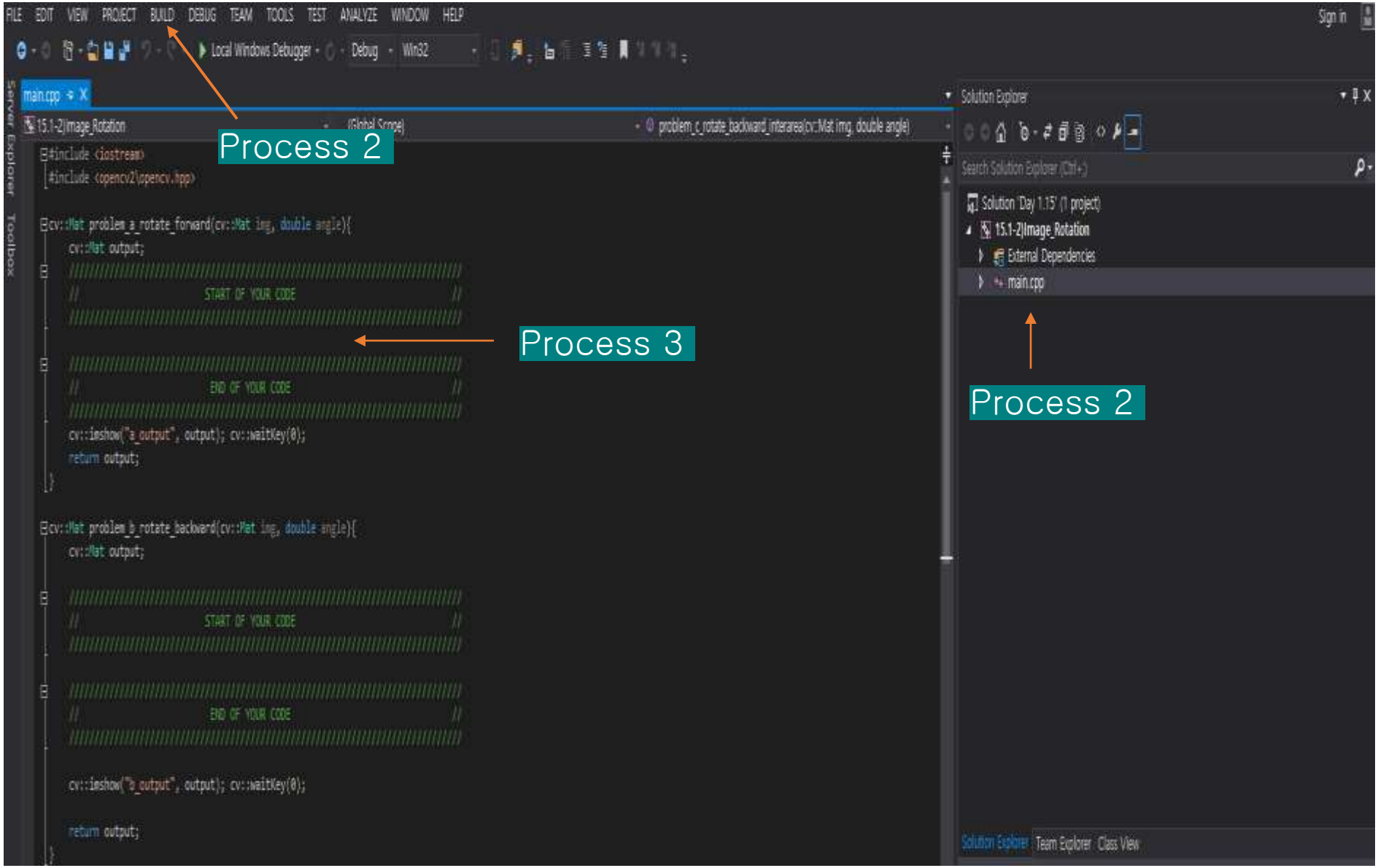
2. Click the build toolbar at the top, and click ‘build solution’ (“Image rotation”).

3. Write your code in “main.cpp” file in “Image_Rotation” Solution.

4. The above processes are outlined on slide 3

5. Environment Settings are written on slide 4.

How to do Exercise



Environment Setup

- Do the Exercise in Visual Studio

(Recommend to use 2013 version. When using a higher version of visual studio, you may encounter some errors.)

- Language : C / C++
- Required packages and libraries : Opencv

(Opencv packages are included in project folder.)

Example Results

- Input Image

A. Forward Method

B. Backward Method

C. Backward and Interpolation