Département Informatique, CNAM
NSY116 - Multimédia et interaction humain-machine -2007-8

Introduction à Processing

P. Cubaud

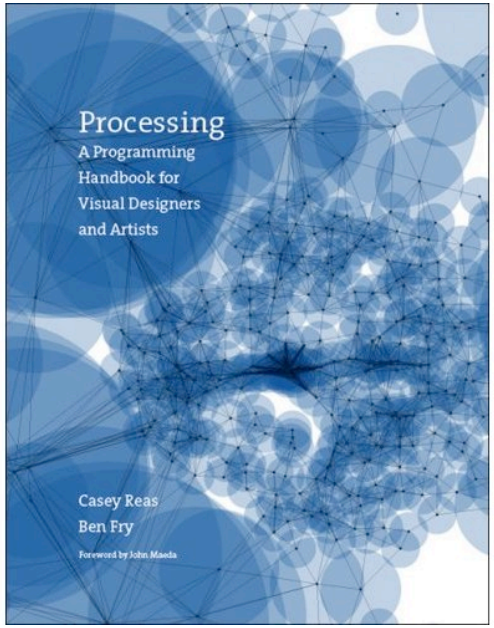
1. L'environnement
2. Le langage
3. Les trois styles de programmation
4. Les libraries
5. Projets associés (sisters) : ex. avec Arduino

http://processing.org

http://www.multimedialab.be/cours/logiciels/processing.htm

http://reas.com/
(ucla)

http://benfry.com/
(mit medialab)

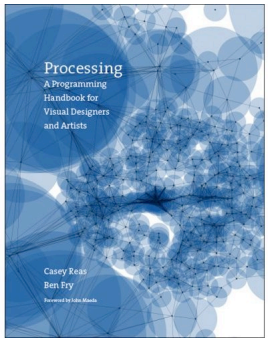


9/2007, 736 p.
MIT Press (35 euros)

We think most “integrated development environments” (Microsoft Visual Studio, Codewarrior, Eclipse, etc.) tend to be overkill for the type of audience we're targeting with Processing. For this reason, we've introduced the 'sketchbook' which is a more lightweight way to organize projects. As trained designers, we'd like the process of coding to be a lot more like sketching. The sketchbook setup, and the idea of just sitting down and writing code (without having to write two pages to set up a graphics context, thread, etc) is a small step towards that goal.The idea of just writing a short piece of code that runs very easily (via a little run button) is a direct descendant of John Maeda's work in Design By Numbers, and our experiences maintaining it. (Yes, other languages and environments have done this first, but in our case, the concept is drawn from DBN).

http://processing.org/faq.html

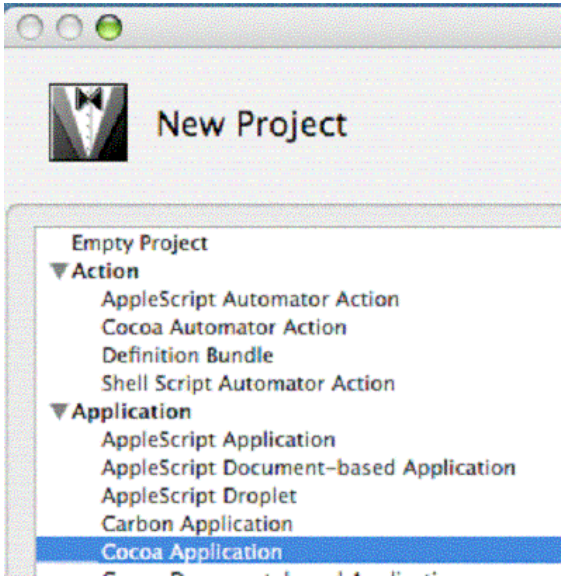
Sketching is necessary for the development of ideas It is necessary to sketch in a medium related to the final medium so the sketch can approximate the outcome. Painters may construct elaborate drawings and sketches before executing the final work. Architects traditionally work first in cardboard and wood to better understand their forms in space. Musicians often work with a piano before scoring a more complex composition. To sketch electronic media, it's important to work with electronic materials. Just as each programming language is a distinct material, some are better for sketching than others, and artists working in software need environments for working through their ideas before writing final code. Processing is built to act as a software sketchbook, making it easy to explore and refine many different ideas within a short period of time.



(p. 2)

Peut-on aller au-delà du « sketch » ?

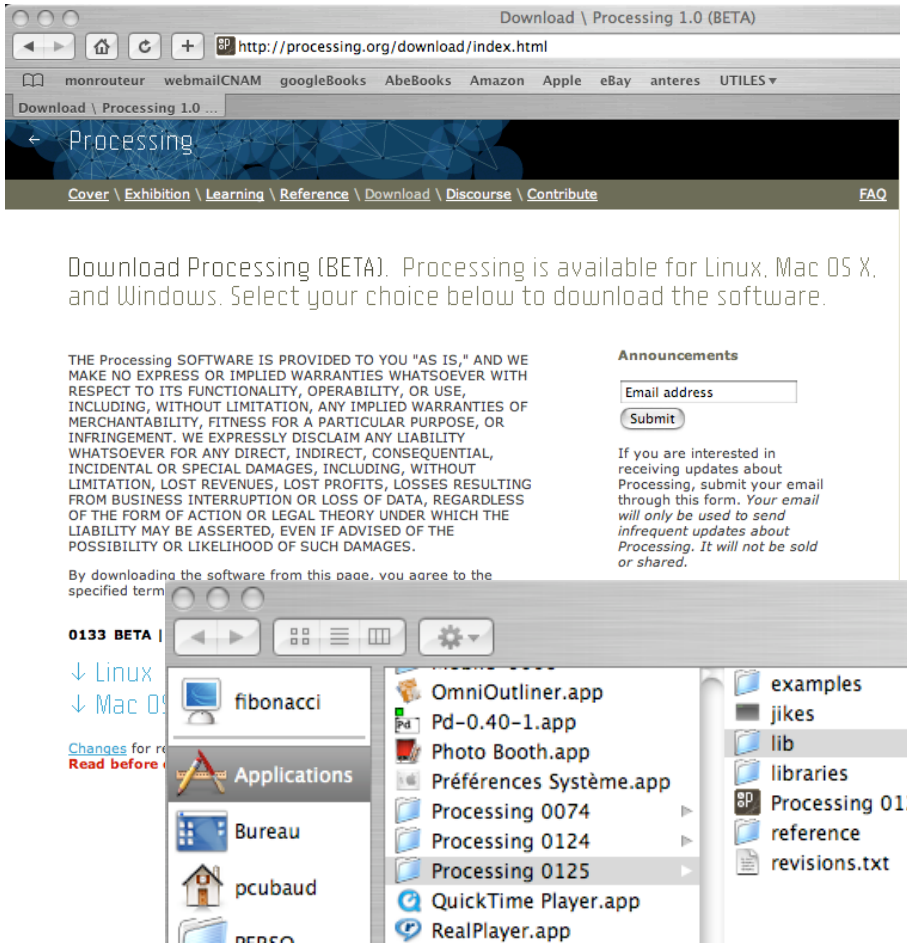
Digression sur Xcode (et autres IDE)



Digression sur Flash

Installation (très simple)

Platforms. The Processing Environment (IDE) runs on various Linux, Windows, and Mac OS X operating systems. Programs written with Processing run on various versions of Java.

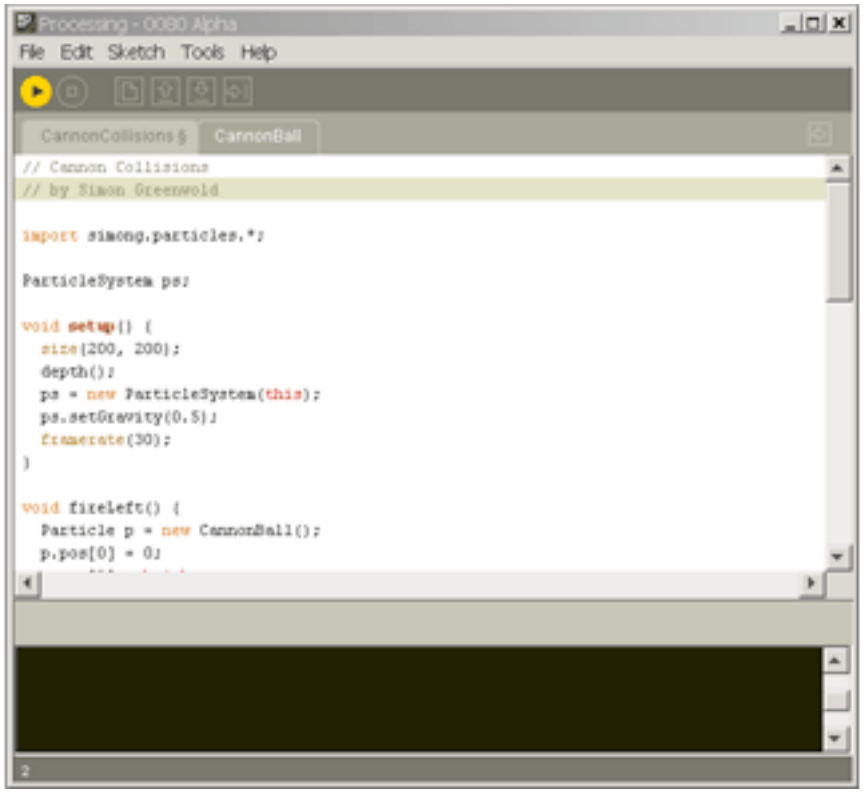


REV 0068 - 2 février 2004
REV 0133 - 26 octobre 2007

Et toujours en version Beta pour la 1.0 !!

Processing Development Environment (PDE)

Display Window



Menu

Toolbar

Tabs

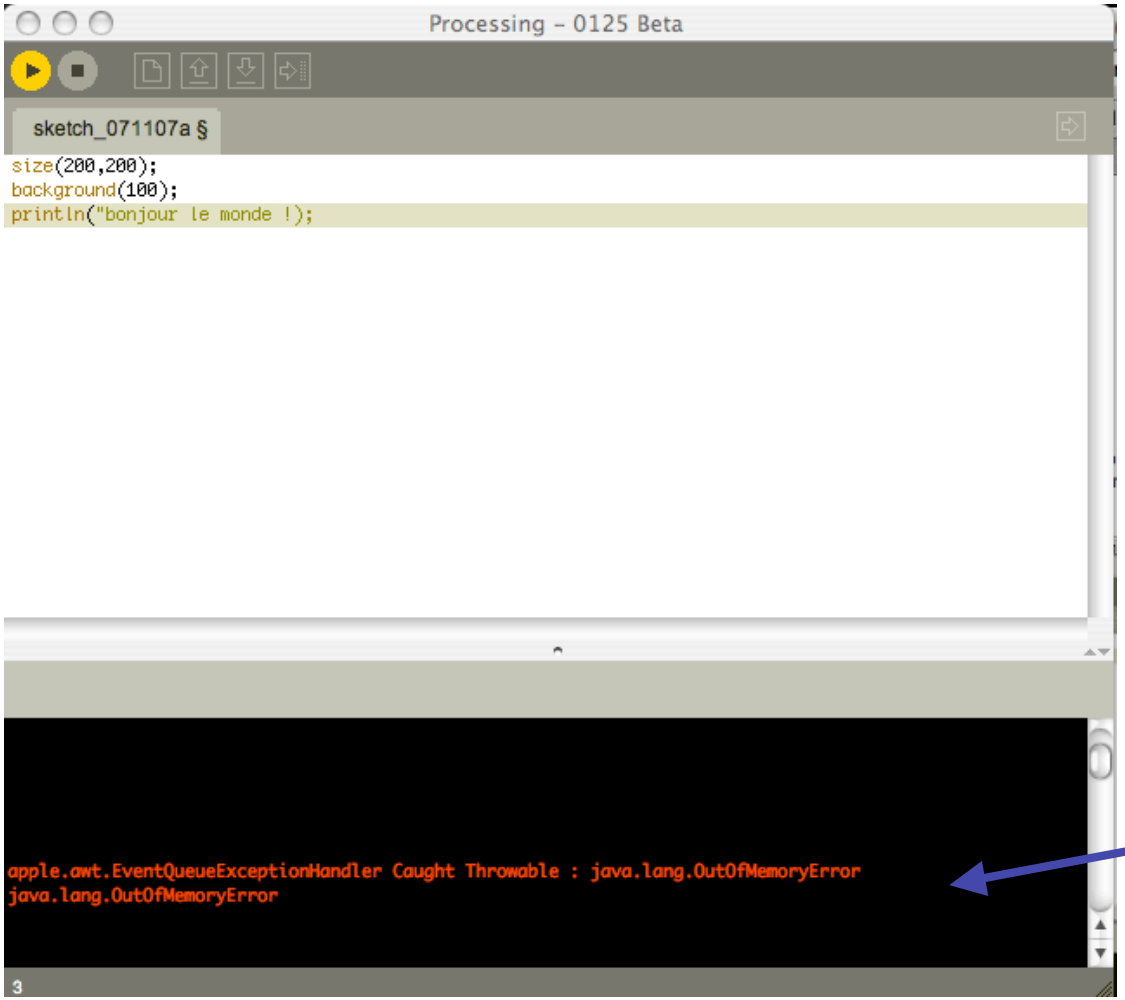
Text Editor

Message Area

Text Area

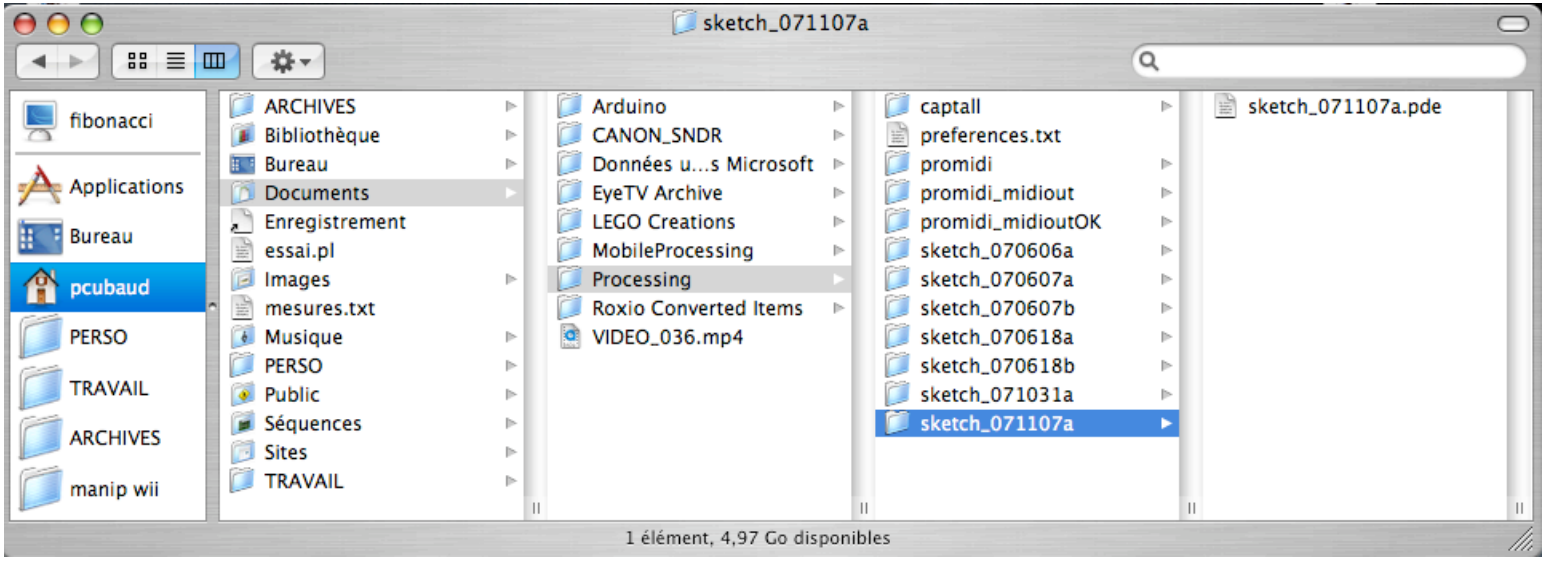
http://processing.org/reference/environment/index.html

Bonjour Monde

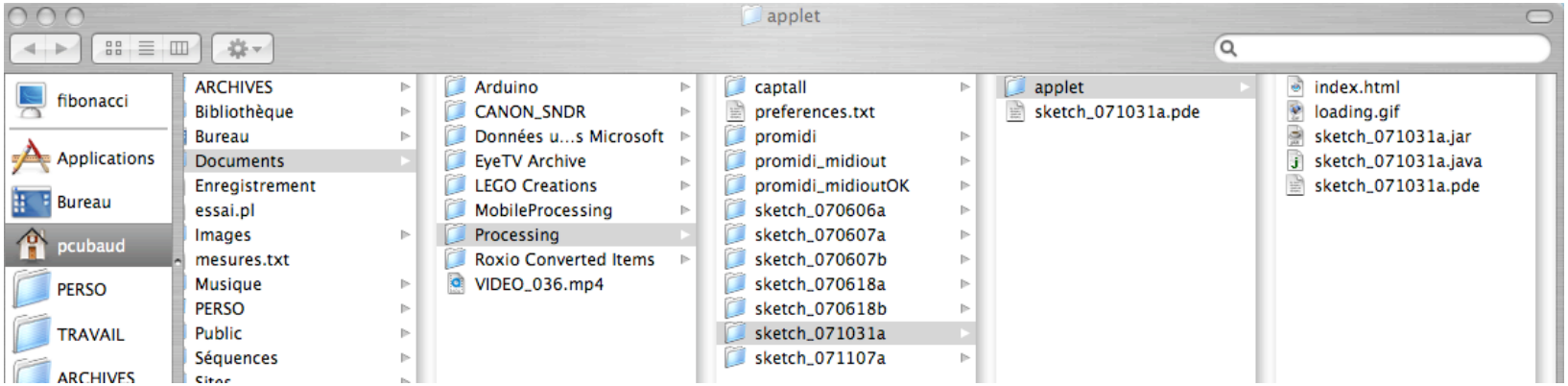


hum…

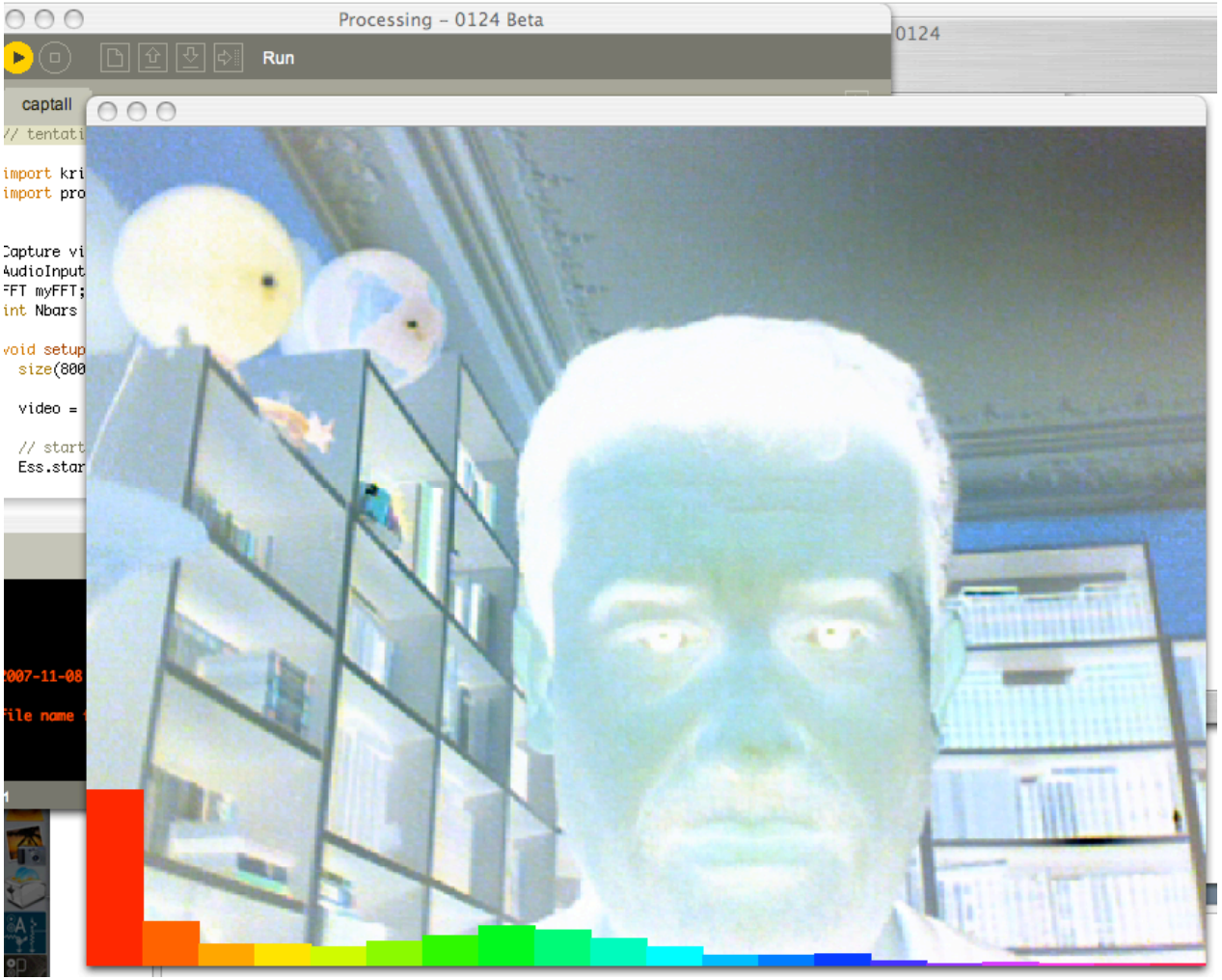
Après la sauvegarde : on crée un fichier .pde rangé par défaut dans le dossier « Documents »



Après un export : création d'un répertoire « applet » :



Bonjour Monde, le retour



Code très court !

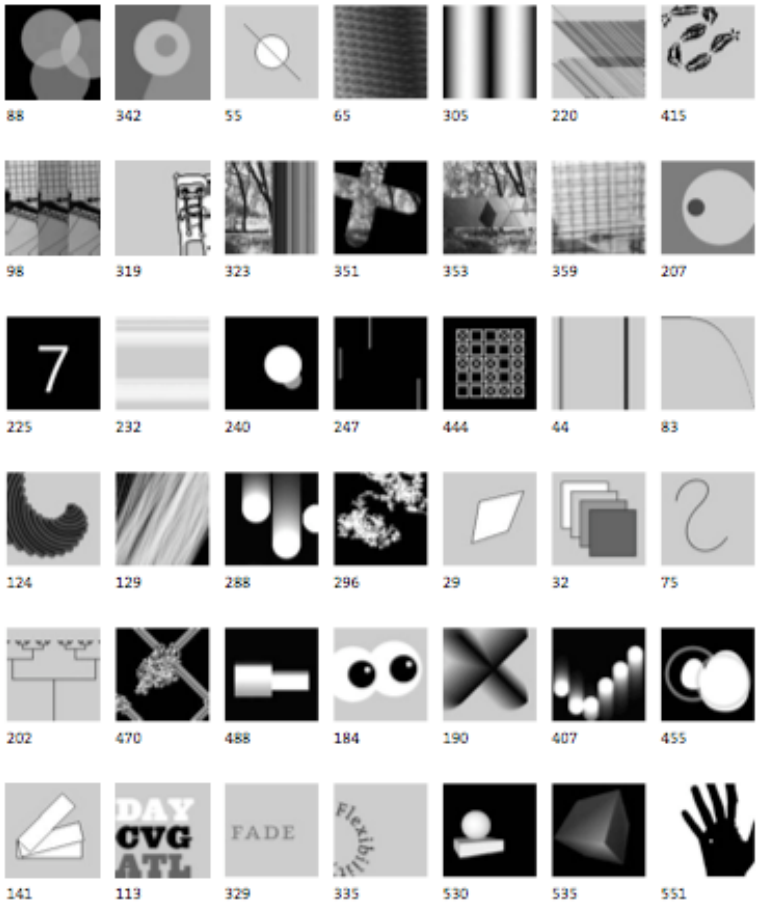
```
// tentative de modulateur PC juin 2007

import krister.Ess.*;
import processing.video.*;

Capture video;
AudioInput myInput;
FFT myFFT;
int Nbars = 20;

void setup() {
  size(800,600);
  noStroke();
  Ess.start(this);
  myFFT=new FFT(512);
  myFFT.limits();
  myFFT.averages(Nbars);
  myInput=new AudioInput(512);
  myInput.start();
}
```

Vidéo ?
Son ?
Dessin ?

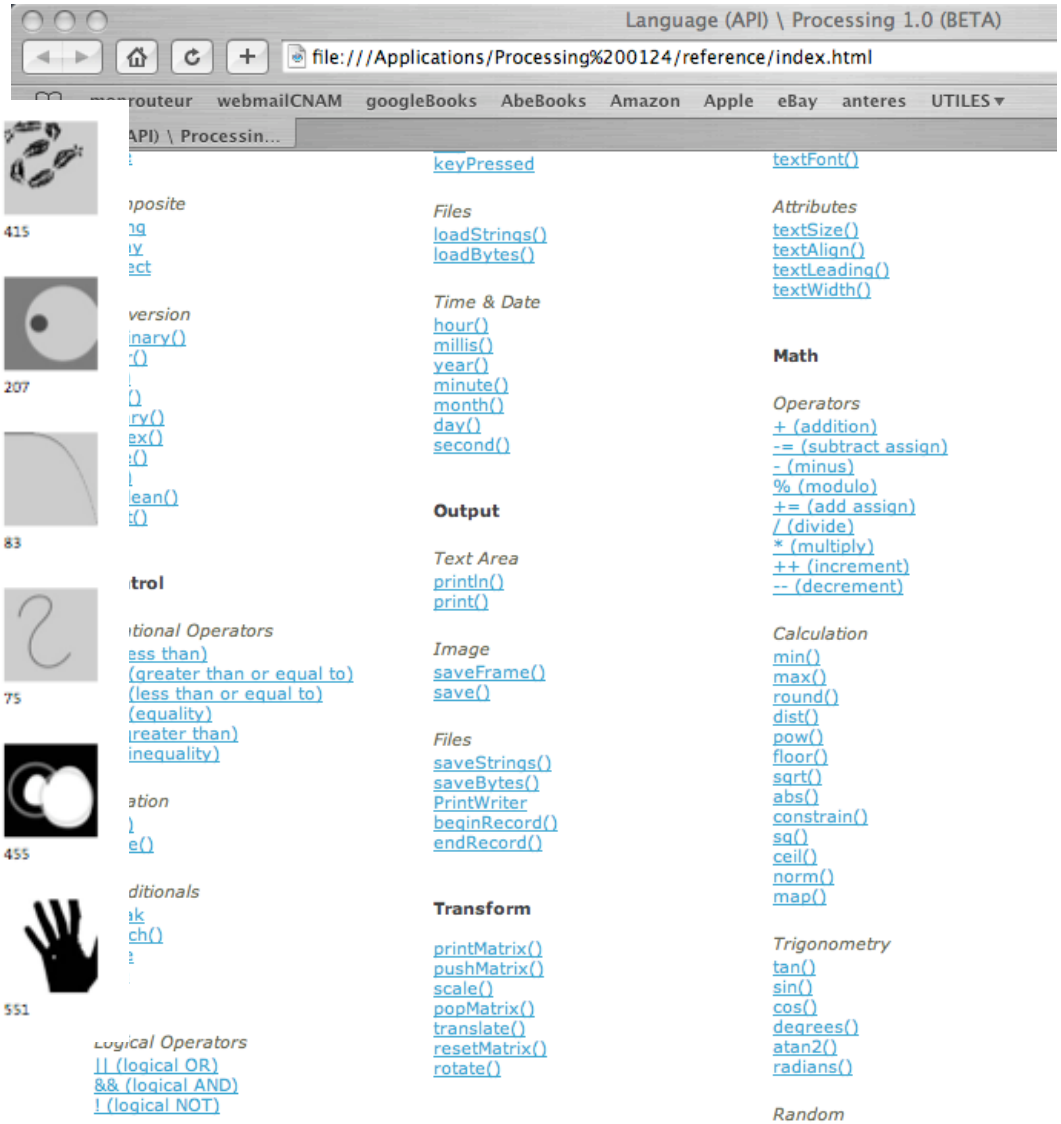
```
void draw() {
  background(0,0,Nbars);
  video.read();
  myFFT.getSpectrum(myInput);
  // coloriage de la video en fct de la fft
  tint(10000*myFFT.maxAverages[0],
       10000*myFFT.maxAverages[1],
       10000*myFFT.maxAverages[2]);
  image(video, 0, 0);
  colorMode(HSB,Nbars);
  for (int i=0; i<Nbars; i++) {
    float x = i*width/Nbars;
    //float y = height*(1.0-myFFT.maxAverages[i]);
    float w = width/Nbars;
    float h = height*myFFT.maxAverages[i];
    fill(i,Nbars,Nbars);
    rect(x,height-h,w+0.5,h);
  }
  colorMode(RGB, 255);
}


public void stop() {
  Ess.stop();
  super.stop();
}

public void audioInputData(AudioInput theInput) {
  myFFT.getSpectrum(myInput);
}
```

2. Le langage (par l'exemple…)

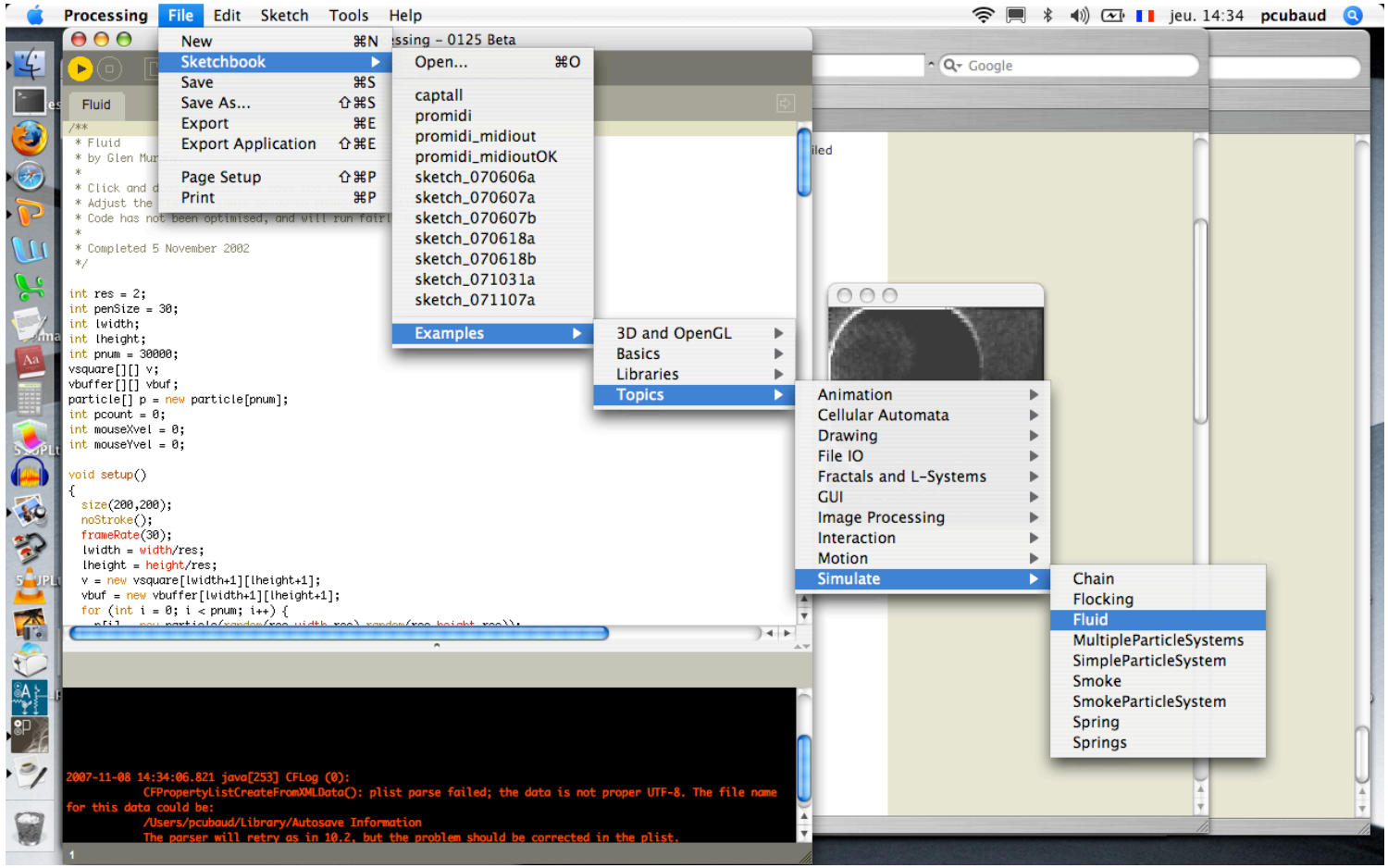
dans le livre



Manuel de ref.

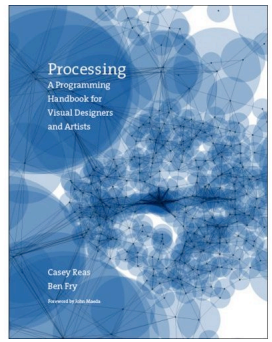


Un exemple de sketch dans le dossier *examples*, parmi 225 (*)



(*) cd /Applications/Processing\ 0125/examples/ ;
ls -lR | grep pde | wc -l

Processing par rapport à Java



p. 688

Input	

`mouseX`
`mouseY`
	`/* Assuming there are two variables in the program named mouseX and mouseY, these values must be changed by the programmer in the mouseMoved() and mouseDragged methods. */`
	
	`public void mouseMoved(MouseEvent e) {`
	`  mouseX = e.getX();`
	`  mouseY = e.getY();`
	`}`
	
	`public void mouseDragged(MouseEvent e) {`
	`  mouseX = e.getX();`
	`  mouseY = e.getY();`
	`}`

`void mousePressed() {`
`  // Statements`
`}`
	`public void mousePressed(MouseEvent e) {`
	`  // Statements`
	`}`

`if (key == 'a') {`
`  // Statements`
`}`
	`public void keyPressed(KeyEvent e) {`
	`  char key = e.getKeyChar();`
	`  if (key == 'a') {`
	`  // Statements`
	`  }`
	`}`

Processing par rapport à Python

```
/// calcul des coef. transformee de Fourier

float[] u = {0,0.262,0.524,0.786,1.047,1.309,0,-1.309,-1.047,-0.786,-0.524,-0.262};

int  N = 12;
int R = 6;
float a = 0;

for (int k=0;k<N;k++) {
 a += u[k];
}
a *= 1.0/N;
println("a0 : "+a);
```

```
### calcul des coef. transformee de Fourier

u = [0,0.262,0.524,0.786,1.047,1.309,0,-1.309,-1.047,-0.786,-0.524,-0.262]
N = 12
R = 6

a = 0
for k in range(0,N) :
    a += u[k]
a *= 1/N
print "a0 : ",a
```

Pas juste une affaire de crochets et d'accolades !

Types élémentaires :

Name Size Value range

boolean 1 bit true or false
byte 8 bits -128 to 127
char 16 bits 0 to 65535
int 32 bits -2,147,483,648 to 2,147,483,647
float 32 bits 3.40282347E+38 to -3.40282347E+38
color 32 bits 16,777,216 colors

Types constructeurs : String, array, objets

Contrôle du flot : if-else, while, for …

Fonctions prédéfinies usuelles (chaines, math, temps, fichiers …)

Fonctions (avec surcharge, récurrence possible)

3. Les trois styles de programmation

1) Basic

This mode is used drawing static images and learning fundamentals of programming. Simple lines of code have a direct representation on the screen.

2) Continuous

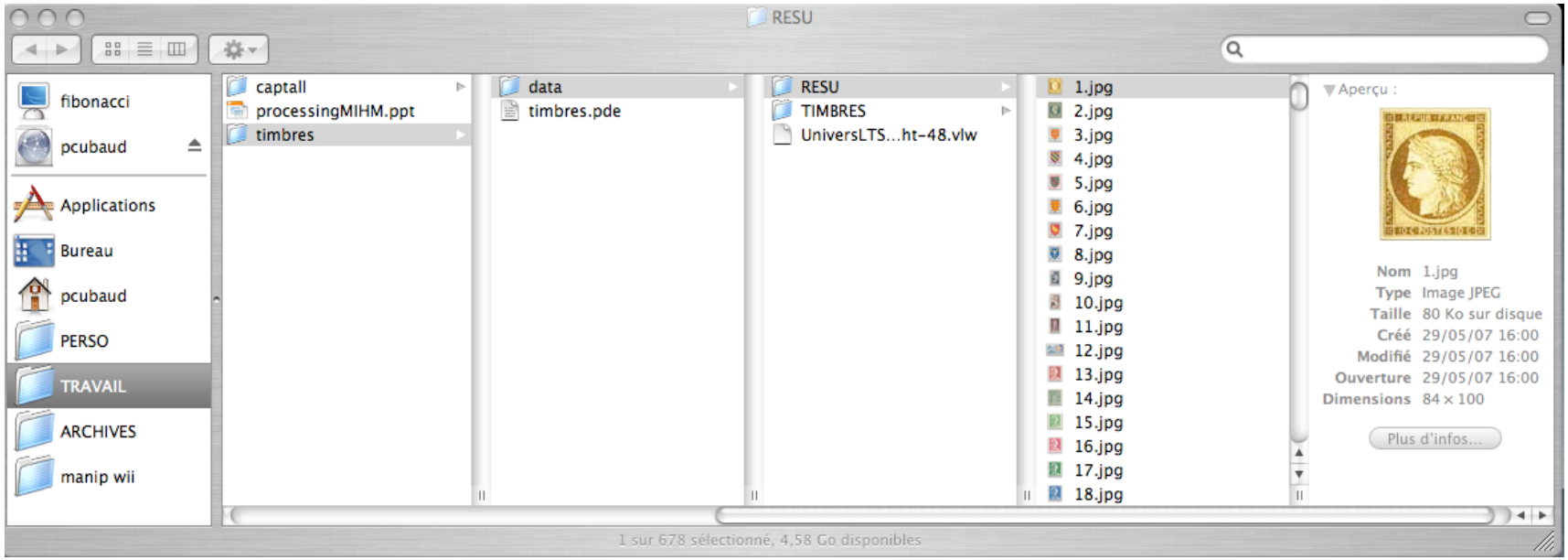
This mode provides a setup() structure that is run once when the program begins and a draw() structure which by default continually loops through the code inside. This additional structure allows writing custom functions and classes an using keyboard and mouse events.

3) Java

This mode is the most flexible, allowing complete Java programs to be written from inside the Processing Environment. Writing in Java Mode removes the limitations of the Processing Libraries and gives access to the full Java programming language.

3.1 Exemple en mode basic : fabriquer des planches de timbres

motivation : travaux de recherche au CNAM/CEDRIC sur la visualisation de grandes masses de documents, pour en particulier encourager la découverte accidentelle



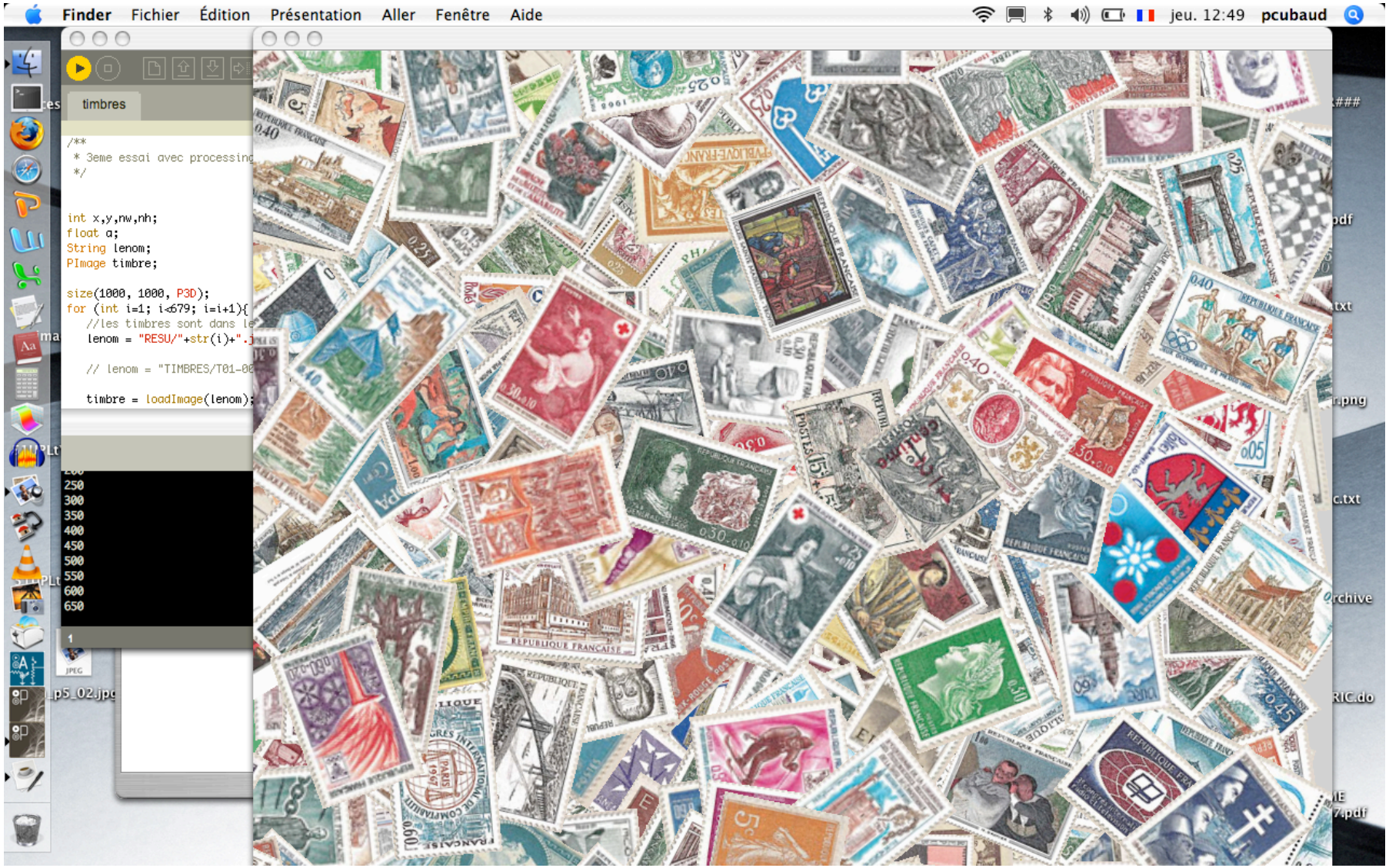
Ici, un répertoire avec 678 imagettes de timbres

Le code

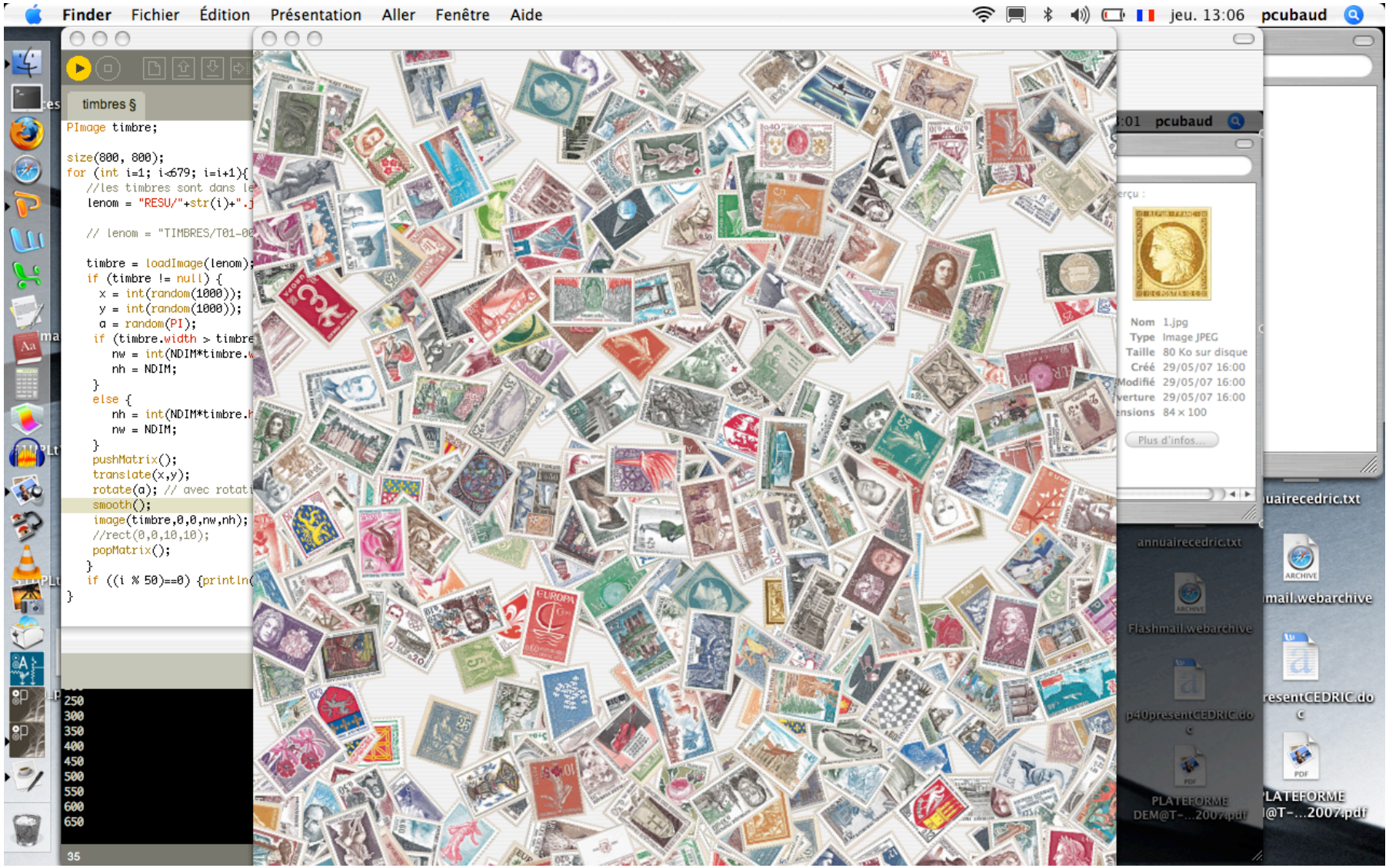
(commenter)

```
Int NDIM  = 100;
int x,y,nw,nh;
float a;
String lenom;
PImage timbre;

size(1000, 1000, P3D);
for (int i=1; i<679; i=i+1){
  //les timbres sont dans le repertoire RESU
  lenom = "RESU/"+str(i)+".jpg";
  timbre = loadImage(lenom);
  if (timbre != null) {
    x = int(random(1000));
    y = int(random(1000));
    a = random(PI);
   if (timbre.width > timbre.height) {
      nw = int(NDIM*timbre.width/timbre.height);
      nh = NDIM;
   }
   else {
      nh = int(NDIM*timbre.height/timbre.width);
      nw = NDIM;
   }
   pushMatrix();
   translate(x,y);
   rotate(a); // avec rotation, sinon mettre en commentaire
   //smooth();
   image(timbre,0,0,nw,nh);
   popMatrix();
  }
  if ((i % 50)==0) {println(i);}
}
```

Résultat (NDIM=100)

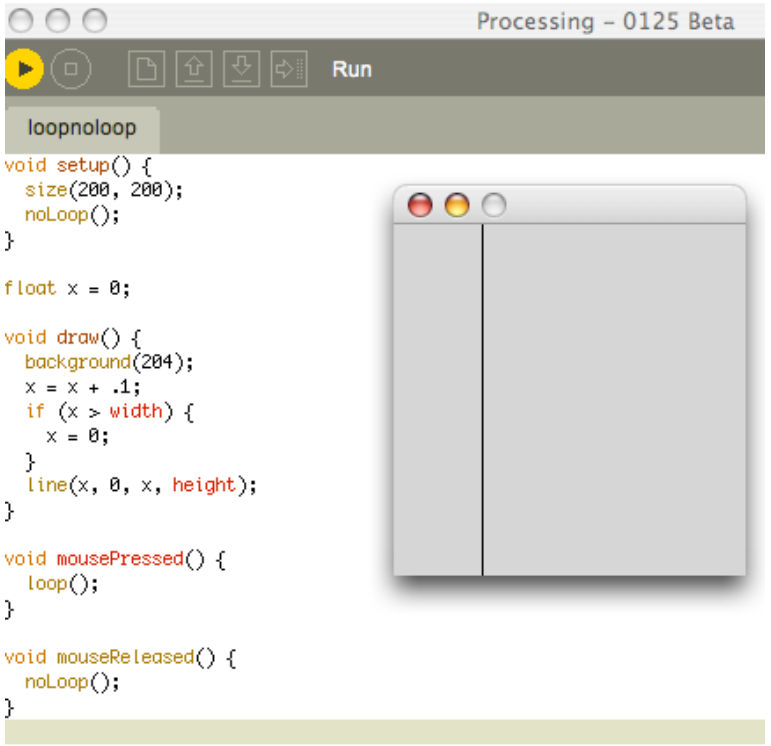


Résultat (NDIM=50)



3.2 Exemple en mode continuous (extrait du manuel de ref.)

```
void setup() {
  size(200, 200);
  noLoop();
}

float x = 0;

void draw() {
  background(204);
  x = x + .1;
  if (x > width) {
    x = 0;
  }
  line(x, 0, x, height);
}

void mousePressed() {
  loop();
}

void mouseReleased() {
  noLoop();
}
```



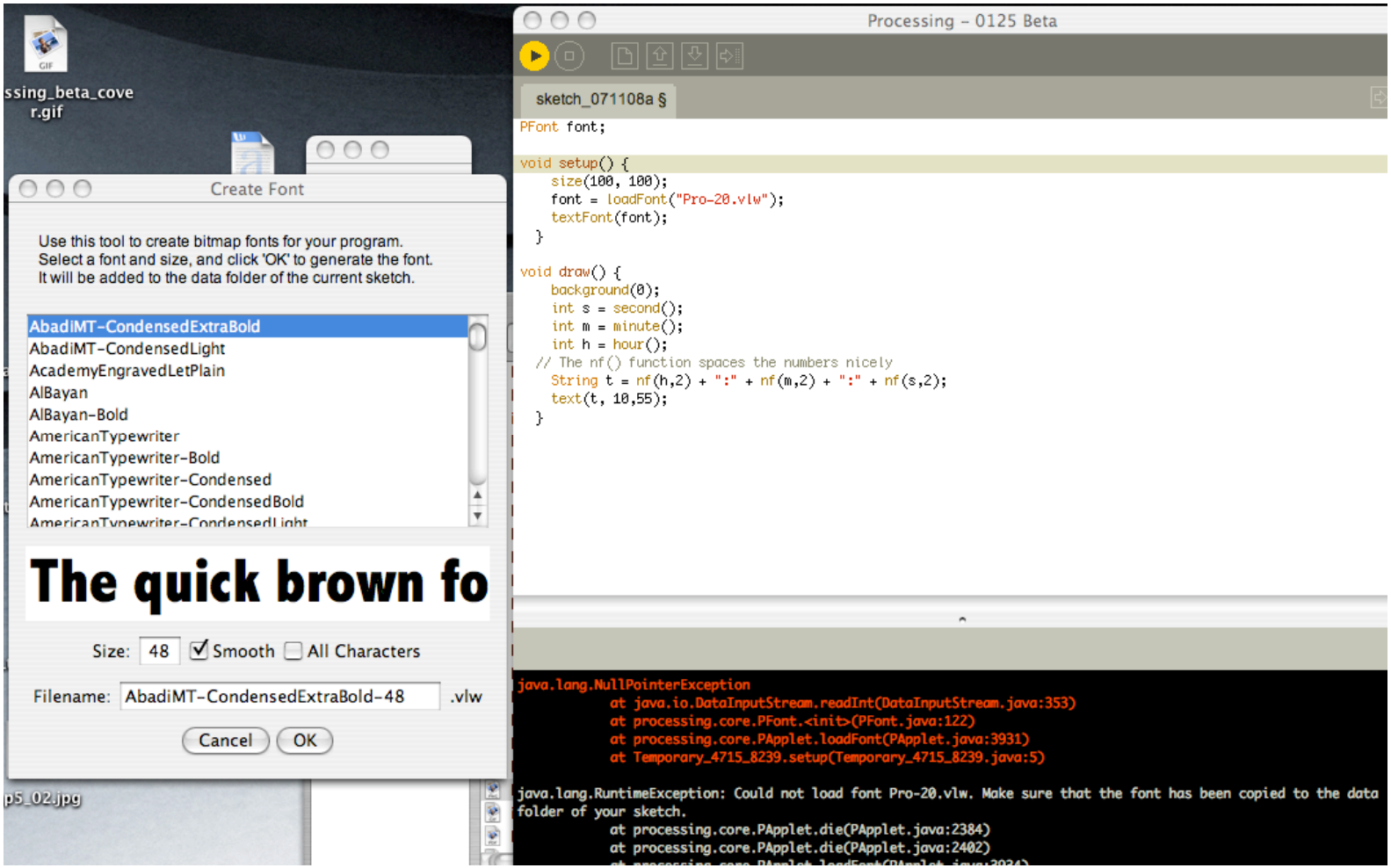
Un autre exemple avec gestion du temps

Processing - 0125 Beta

ilestlor §

```
PFont font;

void setup() {
    size(100, 100);
    font = loadFont("Geneva-20.vlw");
    textFont(font);
  }

void draw() {
    background(0);
    int s = second();
    int m = minute();
    int h = hour();
  // The nf() function spaces the numbers nicely
    String t = nf(h,2) + ":" + nf(m,2) + ":" + nf(s,2);
    text(t, 10,55);
  }
```

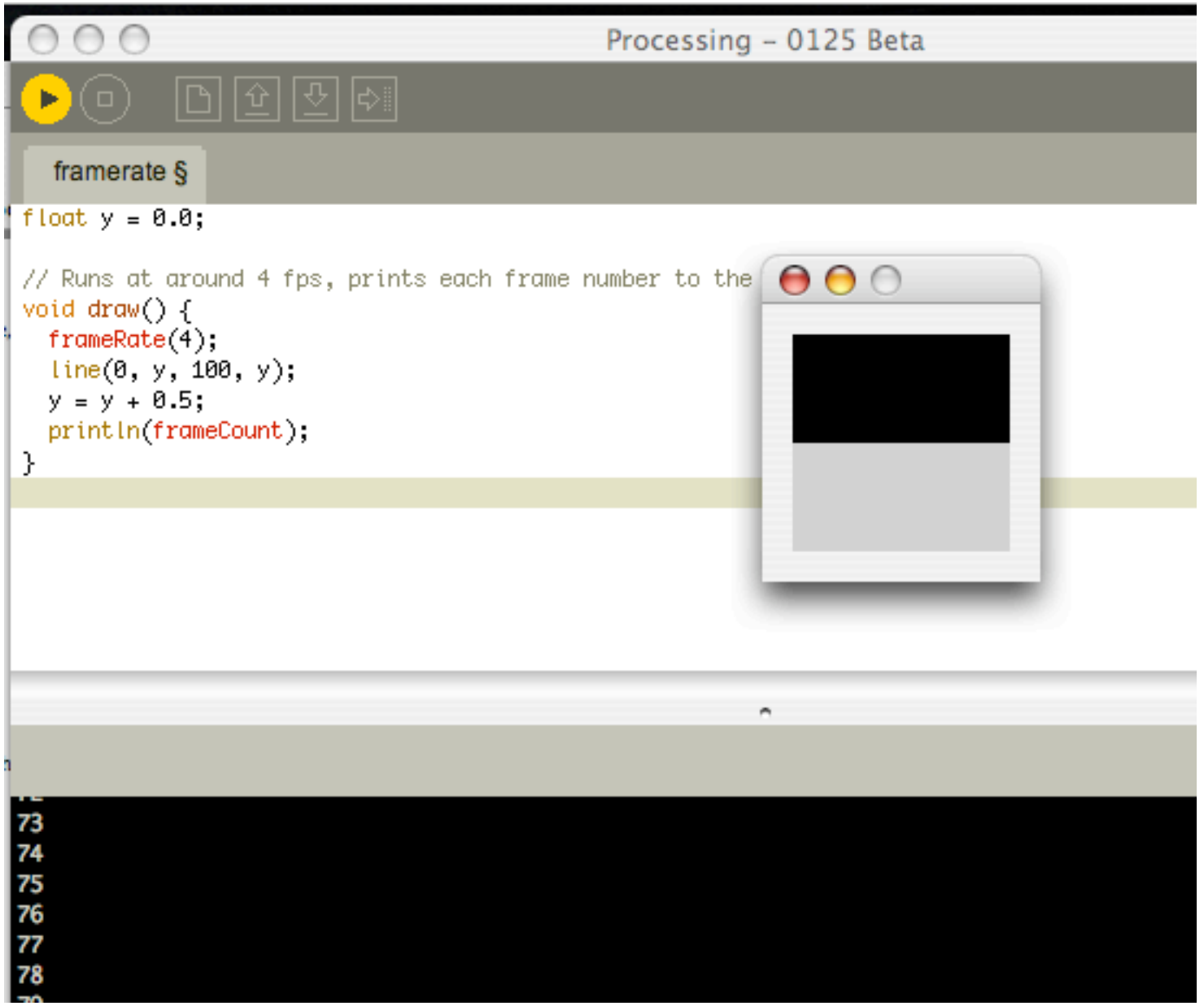
Digression sur les fontes



Générées par un outil de l'env.

Ajoutées dans un dossier *data* du sketch

Digression sur le frame-rate

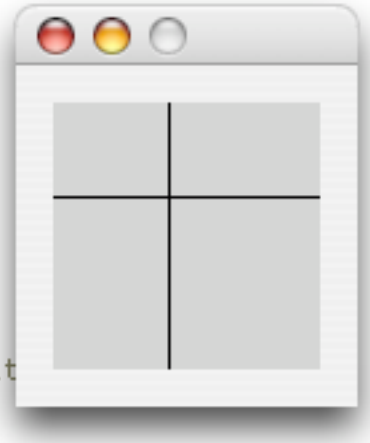


un autre exemple

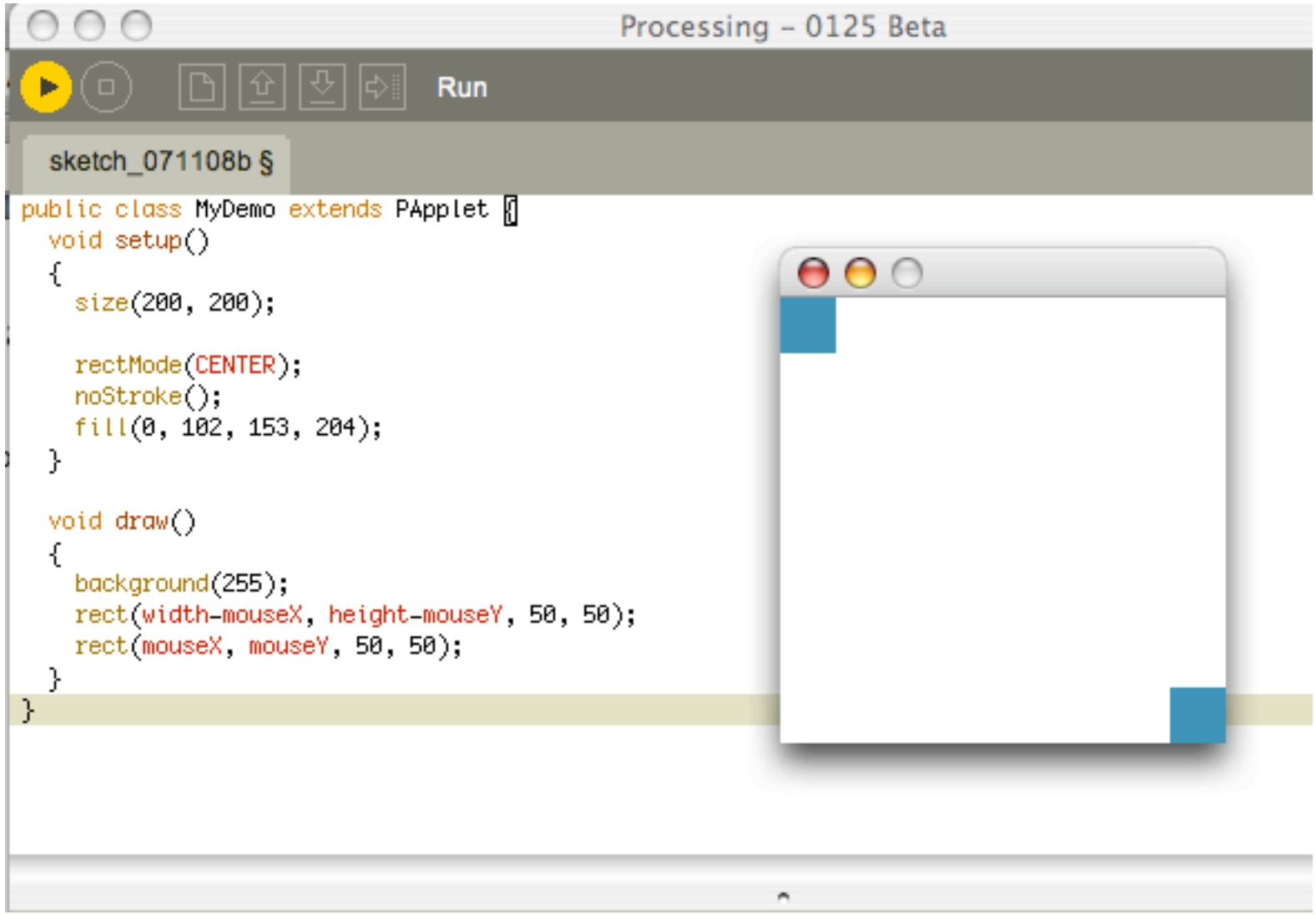
Processing - 0125 Beta

sketch_071108b §

```
int frame = 0;
void setup() {
  size(100, 100);
  frameRate(30);
}
void draw() {
  if (frame > 60) { // If 60 frames since the mouse
    noLoop(); // was pressed, stop the program
    background(0); // and turn the background black.
  } else { // Otherwise, set the background
    background(204); // to light gray and draw lines
    line(mouseX, 0, mouseX, width); // at the mouse posit
    line(0, mouseY, height, mouseY);
    frame++;
  }
}
void mousePressed() {
  loop();
  frame = 0;
}
```

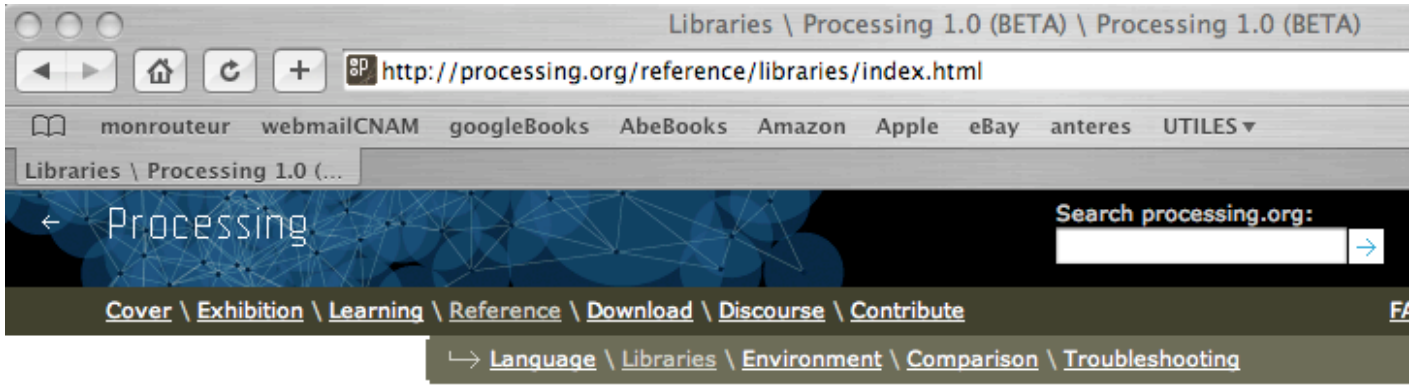


3.3 Exemple en mode java (manuel de ref.)



On peut utiliser un autre IDE, comme Eclipse

4. Les librairies : de base (core) ou tierces (contributors)



Libraries. Extending Processing beyond graphics and image, libraries enable audio, video, and communicating with other devices.

Core Libraries

Video
Interface to Apple's QuickTime for using a camera, playing movie files, and creating movies.

Network
Sending and receiving data via the Internet through the creation of simple clients and servers.

Serial
Supports sending data between Processing and external hardware via serial communication (RS-232).

Candy SVG Import
A minimal SVG file importer. Loads and displays vector files.

XML Import
A minimal XML importer.

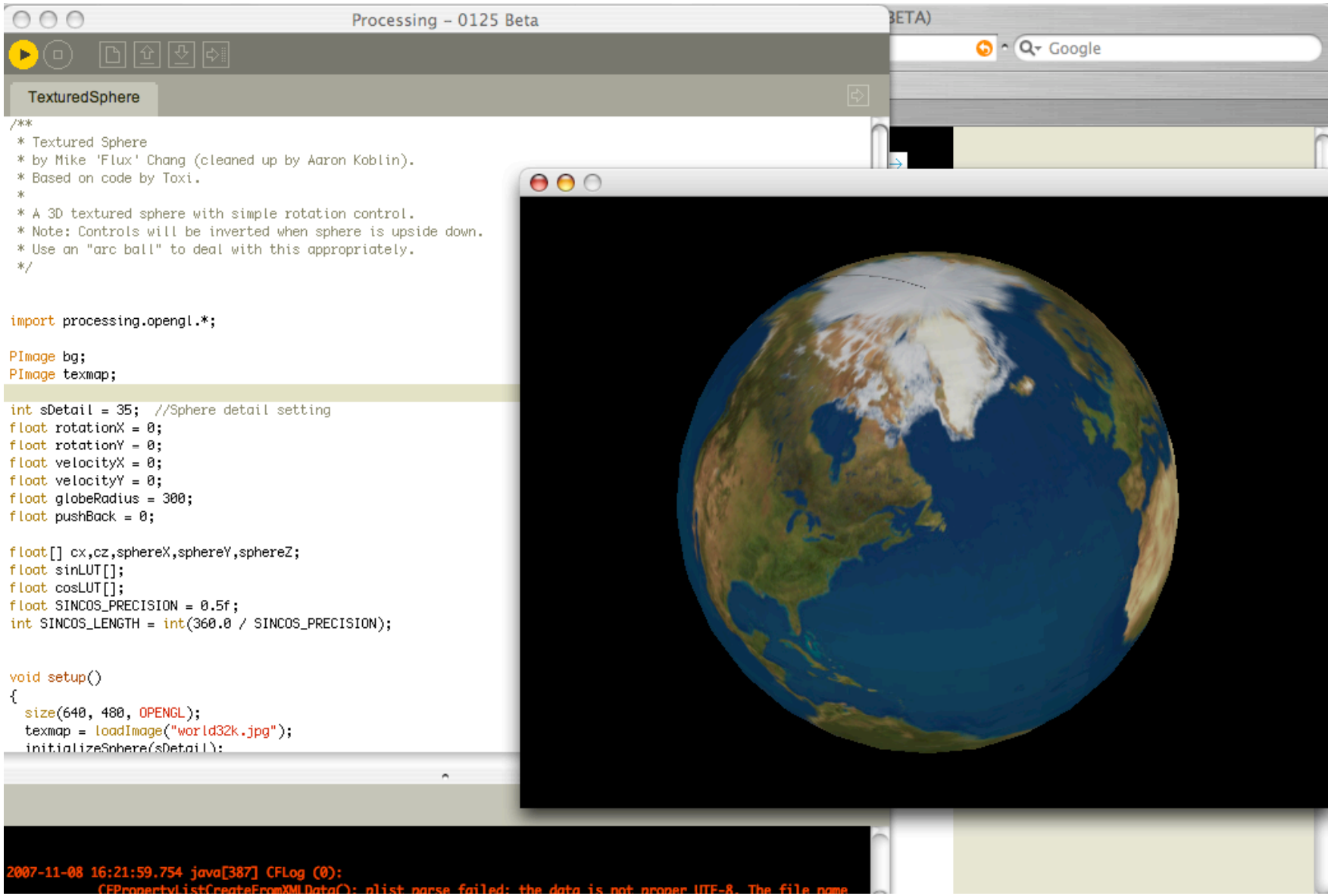
OpenGL
Support for exporting OpenGL accelerated sketches. Utilizes the JOGL library.

PDF Export
Generates PDF files.

DXF Export
Lines and triangles from P3D or OPENGL rendering modes can be sent directly to a DXF file.

» Netscape.JavaScript
Methods for interfacing between Javascript and Java Applets exported from Processing.

Exemple de librairie de base : 3D sur opengl



Les contribs : plus d'une cinquantaine à ce jour !
Assez inégal

Contributions

Sound

» Minim
by Damien Di Fede
Uses the JavaSound API to provide an easy-to-use audio library. A simple API while still providing a reasonable amount of flexibility for more advanced users.

» Ess
by Krister Olsson
Sound library that allows sound sample data to be loaded or streamed, generated in real-time, manipulated, saved, analyzed or simply played back.

» jm-Etude
by Daniel Dihardja
Provides functions to communicate with jMusic for easier music composition programming.

» Sonia
by Amit Pitaru
Audio library for sound playback and synthesis. Integrates Jsyn and requires a browser plugin for playback.

» Sonia Helper
by Marius Watz
Normalizes and damps the FFT analysis values produced by Sonia. This is built into Ess.

Computer Vision

» BlobDetection
by v3ga
Performs the computer vision technique of finding "blobs" in an image.

» reacTIVision TUIO
by Martin Kaltenbrunner
Interface to the reacTIVision vision engine for object tracking.

» LibCV
by toxi
Grabs video frames from a camera using the Java Media Framework (JMF). Does not require QuickTime or WinVDIG for Windows machines.

» JMyron (WebCamXtra)
by Josh Nimoy et al.
Camera library for motion detection, color tracking, glob distinction, and pixel addressing. Does not require QuickTime or WinVDIG for Windows machines.

3D

» OCD
by Kristian Linn Damkjer
The Obsessive Camera Direction (OCD) library allows intuitive control and creation of Processing viewport Cameras.

Compilatio

» unlekkerl
by Marius W
Contains coc
export, Mers
random num
TileSaver cl
images from
tiling the vie
line intersec
complex 2D

Data \ Pro

» Yahoo! S
by Daniel Sh
Access the Y
directly in Pr

» SFTP
by Daniel Shiffman
Allows Processing to use SFTP for secure file transfer; uses JSch (Java Secure Channel).

» Switchboard
by Jeff Crouse
Web services library. Helps in extracting data from services such as Google, Yahoo, Amazon, Del.icio.us, Flickr, and many more.

» proMidi
by Christian Riekoff
Allows Processing to send and receive midi information.

» Collada Export
by Marcus Wendt
Exports 3D geometry and material data in the COLLADA format.

» proSVG
by Christian Riekoff
Exports vector graphics in the .SVG format.

» SimplePostScript
by Marius Watz
Writing vector files in the PostScript format.

Tools

» proDOC
by Christian Riekoff
Generates documentation for Processing libraries from the source code. Requires inserting tags in the comments of the classes, fields, and methods.

» ImageAdjuster
by Dave Bollinger
Performs brightness, contrast, gamma and other such adjustments on images. Contains both high-level and low-level routines, and can be extended via user-defined transformations.

Hardware

» Most Pixels Ever
by Daniel Shiffman and Chris Kairalla
Framework for spanning Processing sketches across multiple screens.

» Gestalt
by d3 and senor pako
Gestalt is an open structured environment, designed to prototype and develop OpenGL- and Java-based sketches and applications.

» Fog
by JohnG
Simple fog effect for Processing using P3D and OPENGL renderers.

» Vector 3D
by Dan Shiffman
The Vector3D class from The Nature of Code course.

Simulation \ Math

» Physics
by Jeffrey Traer Bernstein
Simple particle system physics engine. No collisions, just particles, springs, gravity & drag.

» AI Libraries
by Aaron Steed
A set of libraries to assist with artificial programming tasks such as genetic algorithms and the AStar algorithm.

» Cell Noise
by Carl-Johan Rosén
Explores cell noise (Worley noise), a pattern generation algorithms useful for animation.

» Oscillator
by taka
Useful for generating series of waves.

» proXML
by Christian Riekoff
Allows Processing to read and write XML files.

» Google API
by Tatsuya SAITO
Interface to query web pages through Google search.

» oscP5
by Andreas Schlegel
An OpenSound Control (OSC) implementation for Processing.

» MySQL
by Florian Jenett
Facilitates communication with a MySQL database.

» Carnivore
by RSG
A TCP/UDP packet sniffer library for the Processing programming language.

» MaxLink
by Jesse Kriss
Enables communication between Processing and Max/MSP 4.5

» Monomic
by Jesse Kriss
Enables communication between Processing and the monome 40h device.

» UDP
by Stephane Cousot
Enables simple UDP communication,

» Apple SMS
by Daniel Shiffman
Interface to the Apple Sudden Motion Sensor in PowerBooks (and MacBooks) since 2005.

» Apple Light Sensor
by Martin Rädlinger
Interface to the Light Sensor in MacBook Pro computers.

» NXTComm
by Jorge Cardoso
Allows control of the Lego Mindstorms NXT robots.

Animation and Typography

» Shapetween
by Elie Zananiri and Golan Levin
An easy way to animate elements in a variety of ways.

» NextText
by Elie Zananiri / Obx Labs
Assists in making dynamic and interactive text-based applications.

» MovingLetters
by Ilu
Typeface of moving, jittering letters.

» MatrixMath
by Francis Bitonti
Helpful code for matrix operations.

Interface

» controlP5
by Andreas Schlegel
Custom GUI elements with the ability to show/hide and move while the program is running.

» proCONTROLL
by Christian Riekoff
Allows Processing to communicate with control devices like joysticks and joypads.

» MyGUI
by Markavian
Implements buttons, radio button, checkboxes, sliders, and scroll bars.

» Interfascia
by Brendan Berg
Provides a toolkit of standard interface widgets like text fields, buttons, checkboxes, sliders, etc.

» SpringGUI
by Philipp Seifried

as well as multicast support.

» xmlrpclib
by Burak Arikan
An XML-RPC library for Processing. XML-RPC is a widely adopted Remote Procedure Calling protocol that works over the Internet.

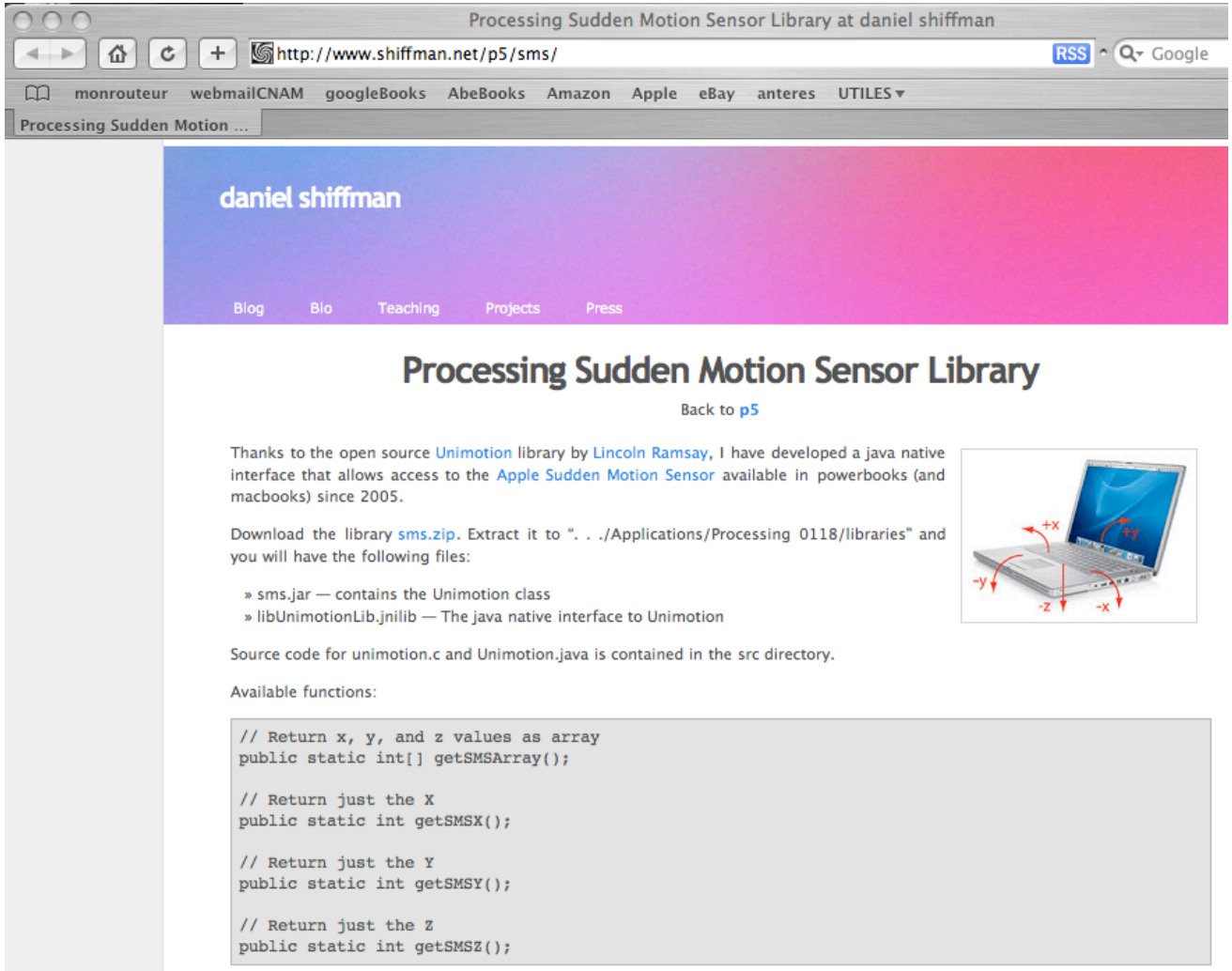
» EnvironmentXML
by Usman Haque
Enables simple access to and from the EnvironmentXML website, which hosts a repository of data feeds from different environments around the world.

» ID3
by Jorge Cardoso
Allows Processing to read the ID3v1.1 tags from MP3 files.

» QRCode
by Daniel Shiffman
Reads QR Code images, a two-dimensional barcode format.

» Social Networks Library
by Todd Holloway
Contains network library components, but emphasizes tools for selecting subsets and traversing the network.

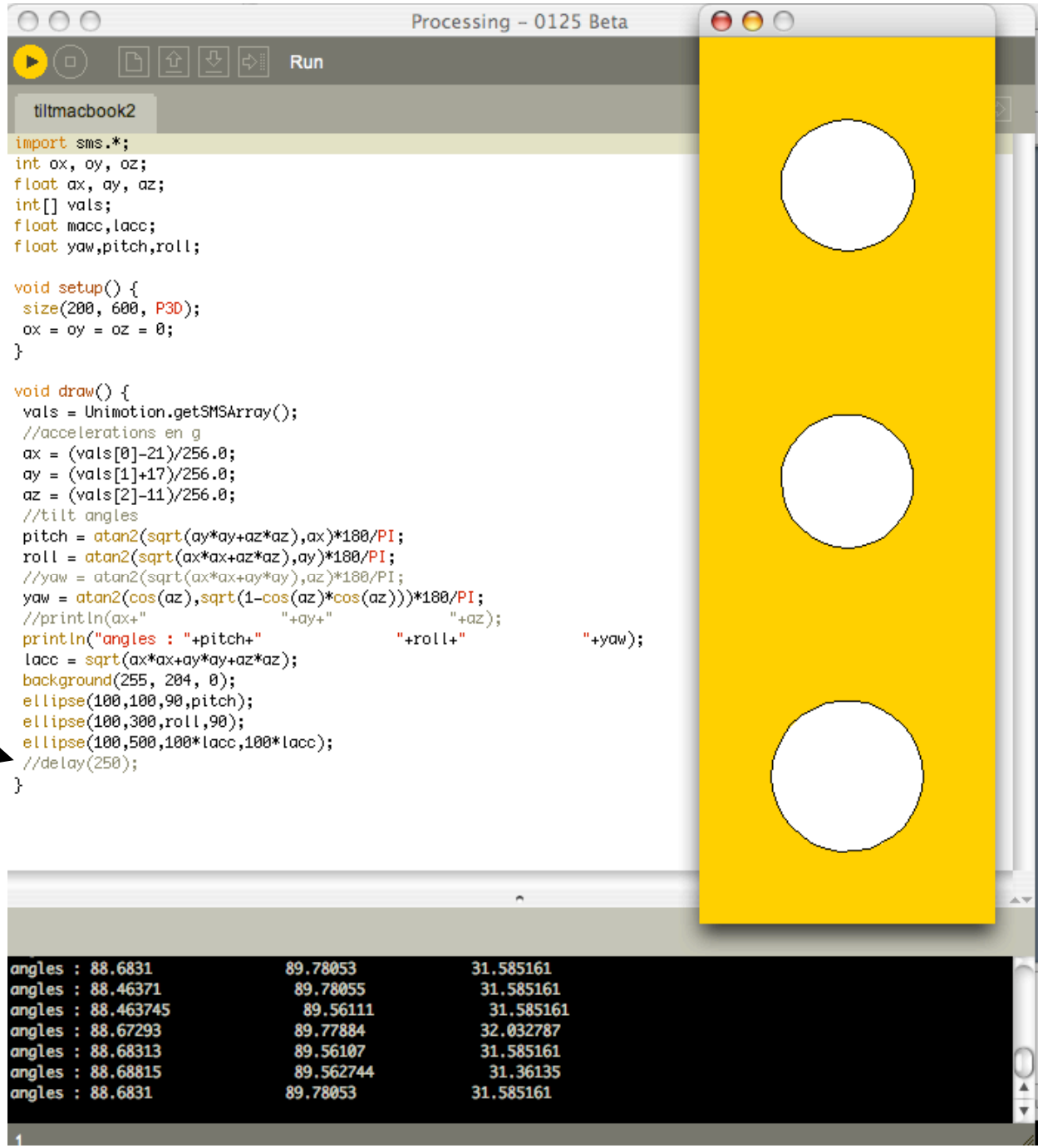
Installation typique : exemple de la librarie AppleSMS (SMS = sudden motion sensor)



Un petit sketch de demo

import

Pb. du framerate



Aute ex. : la
librairie sonore ESS

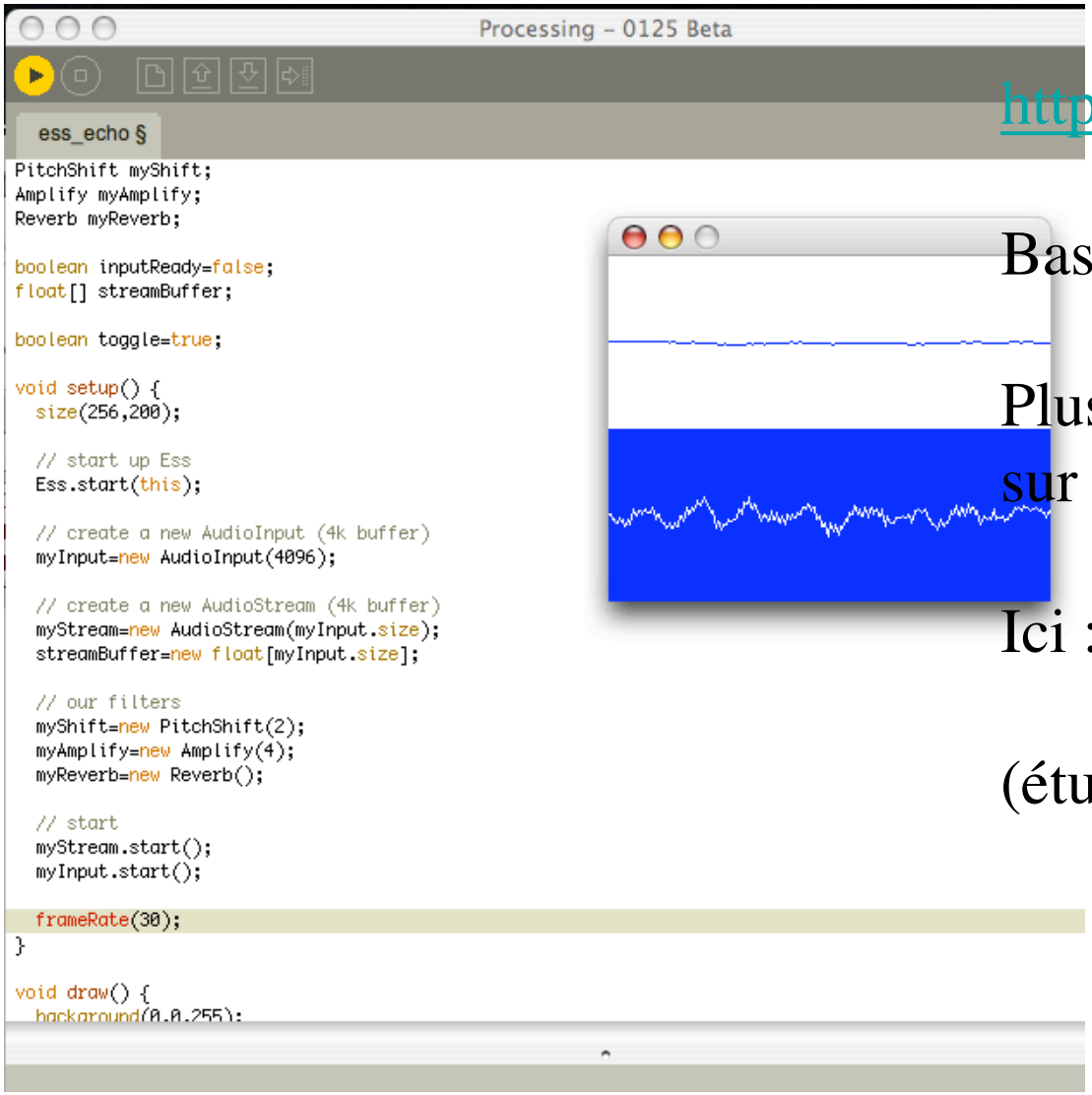
http://www.tree-axis.com/Ess/

Basée sur JavaSound

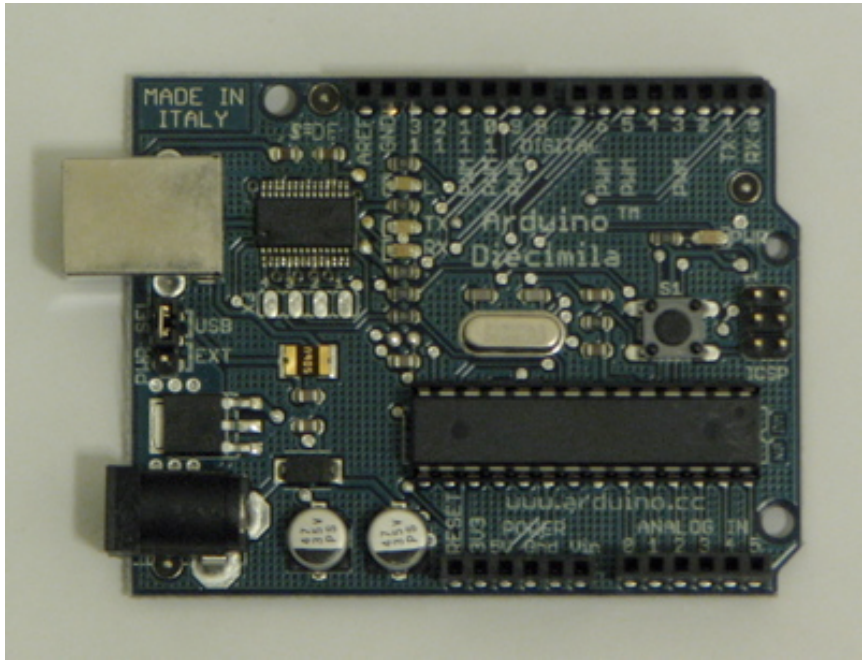
Plusieurs très bons ex.
sur le site

Ici : squirrel-echo

(étudier ce code !)



5. Les projets « fils » (sisters !)



http://www.arduino.cc