Creating Customized Animations for better Comprehension

Thomas Kinsman, Ph.D.

What I'm Talking About:

- I want to be able to create customized GIF or video animations, using a programming tools
- These animations are exactly what I am looking for, and give precise positioning of objects, and customized motions between frames.
- These can be used:
  1. powerpoint (an Microsoft product), or
  2. KeyNote (an Apple product), or
  3. Any presentation framework that supports GIF animations or videos.

Not Covered

- PowerPoint has a library of basic shapes and a huge set of animations that are inherent in the product.
- There is no need to do a customized animation if the standard animation methods work.
- There are many videos on the basics of PowerPoint animations.
  - I recommend you start with this one by Kevin Statvert:

    PowerPoint Animation Tutorial - Learn How To Animate

Presentation Today:

A. Slides to set the stage.

B. Example code – you ask questions later on.

Three Parts:

1. Overview
2. Programming Overview
3. Example Programming in Matlab

Part A

Overview

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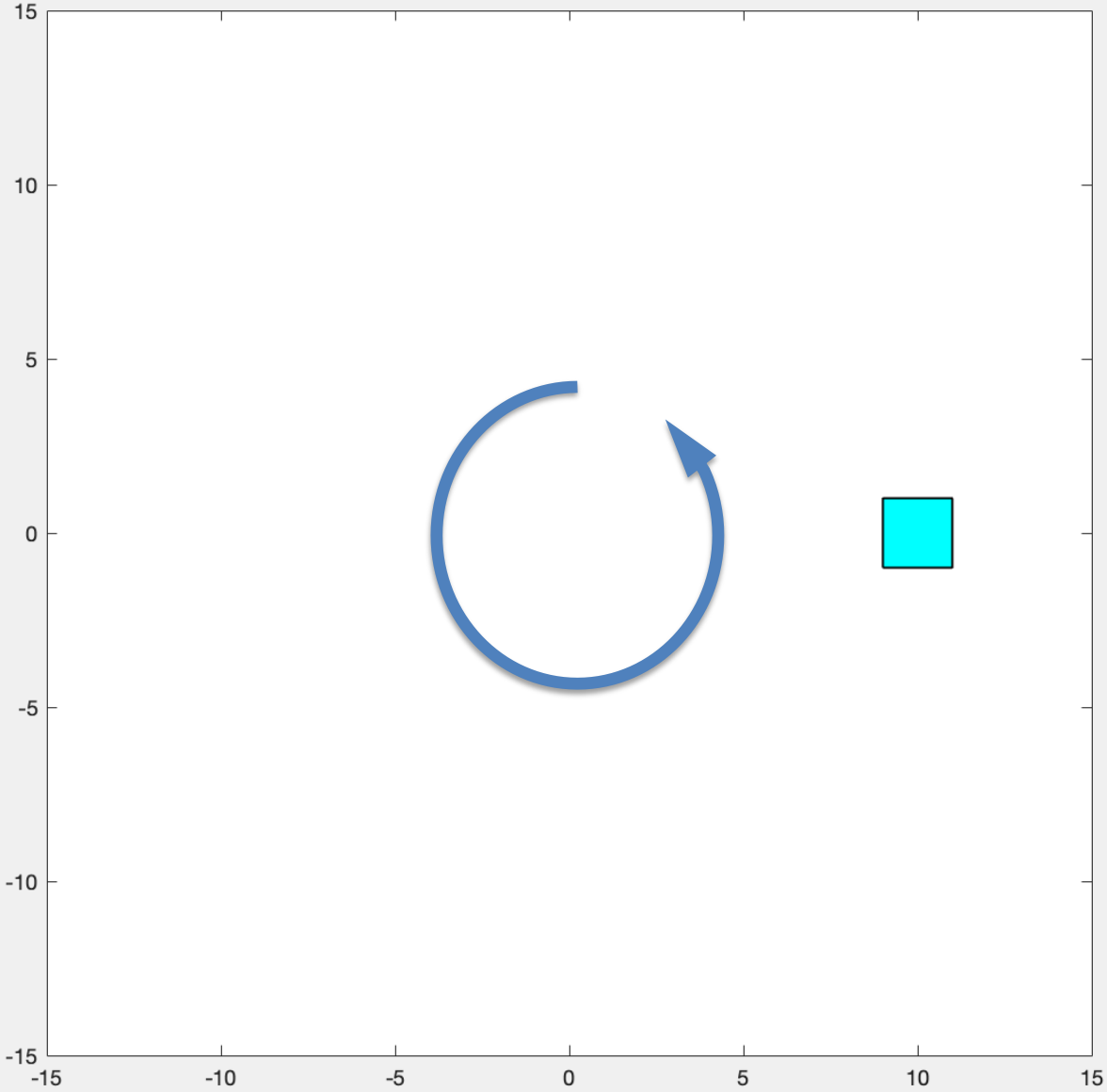
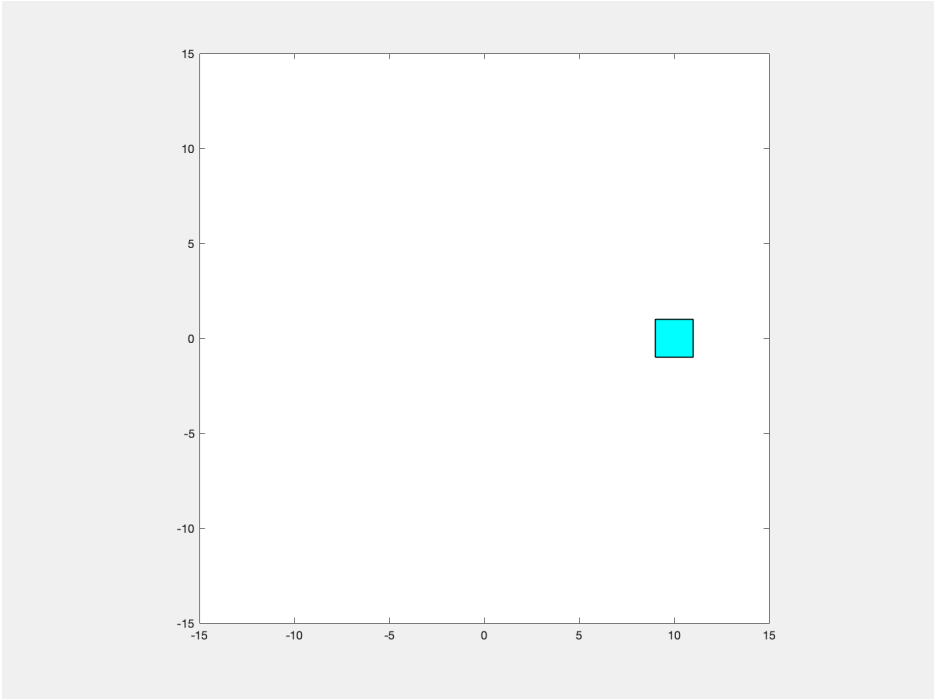
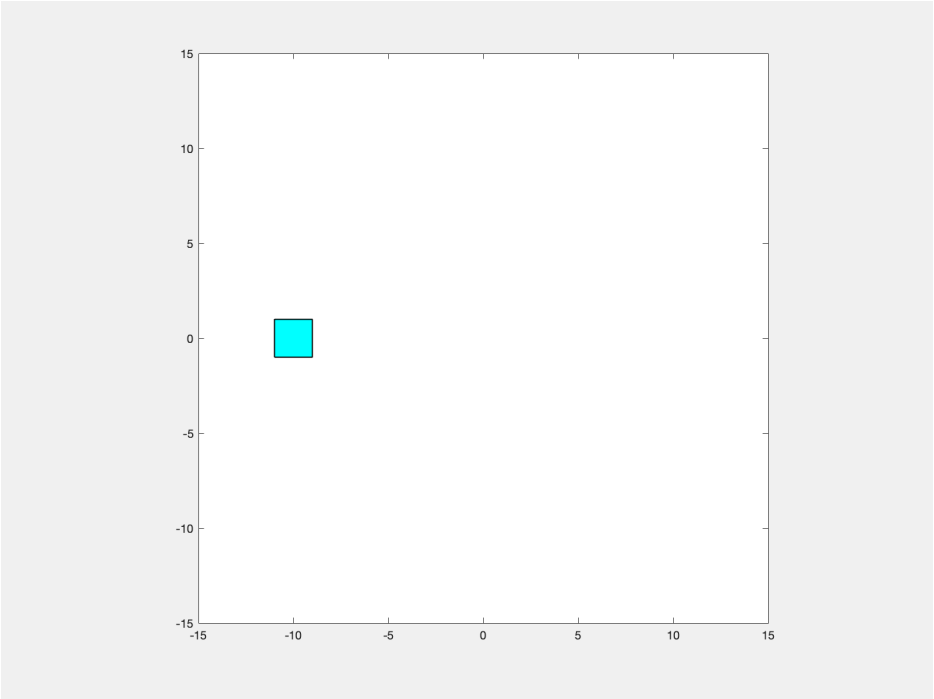


This shows a cyan box, revolving around the page, counter-clockwise.





Without the motion in the animation, the viewer is left to “imagine” the object moving around the frame. This is how I learned, when everything was either in a book, or drawn on a chalkboard.

The Background Problem:

RIT, does not have
a Graphic Arts department.

The Goal:

- Want to create precisely perfect picture

- Or, I want to create a question bank for online quizzes with dozens of images – each slightly different. Using a computer program I can create 50 different figures.

Problem:

- Typically, PowerPoint uses hand-make diagrams, which requires a significant investment in time.
- The time required prevents lecturers from making complex diagrams.
- Animations shows how changes occur *over time* and avoids losing students when switching between slides. The motions and changes direct student attention to specific regions, information, and concepts.

Learning by Example:

- In the workshop (which was cancelled to save time) participants would have worked through an example of creating an exact GIF animation in Matlab.
- Instead, examples will be presented and discussed.
- You can then extend these concepts for your own usage.

The Key Points:

1. Be Determined – You can do this!
    a. Do not be intimidated
2. Plan:
    a. Storyboard
    b. Get a pencil and sketch
3. Create ONE FIGURE – one frame
4. Create several figures
5. Put the figures together into one file

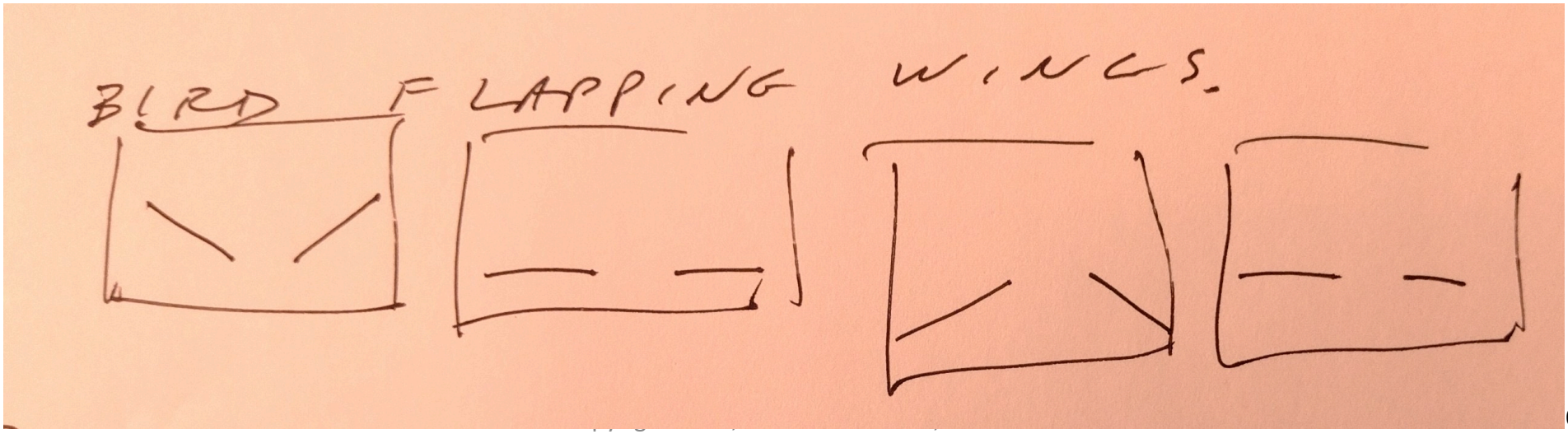
Step 1 : Be Determined

- If a fifth-grade student can do this without the internet in 1972, you can do this.

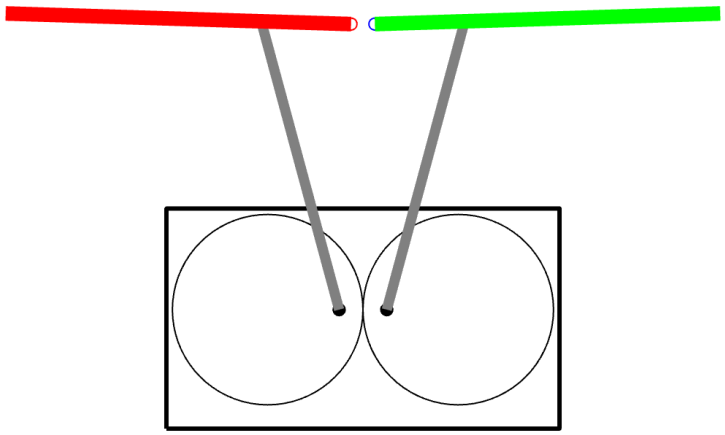
- You can do this!

Step 2: Storyboard

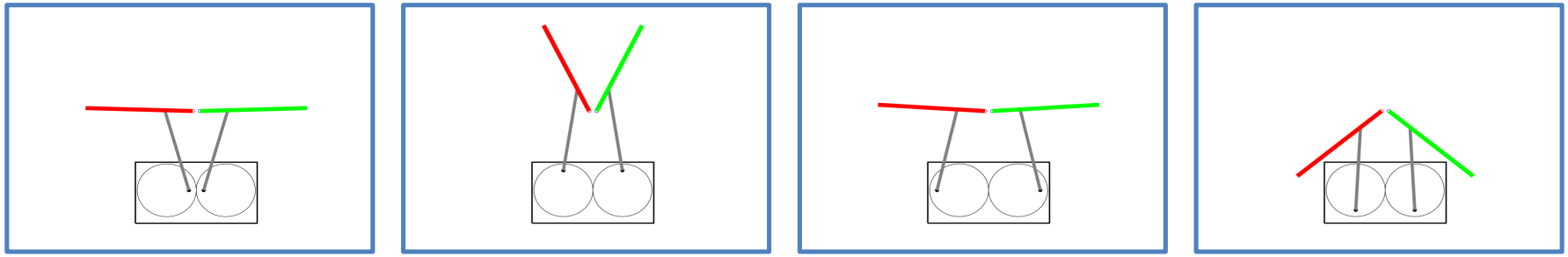
- Physically sketch what you want your figure or animation to look like
- Sketch several frames
- Figure out what changes between frames
  - These are the *parameters*



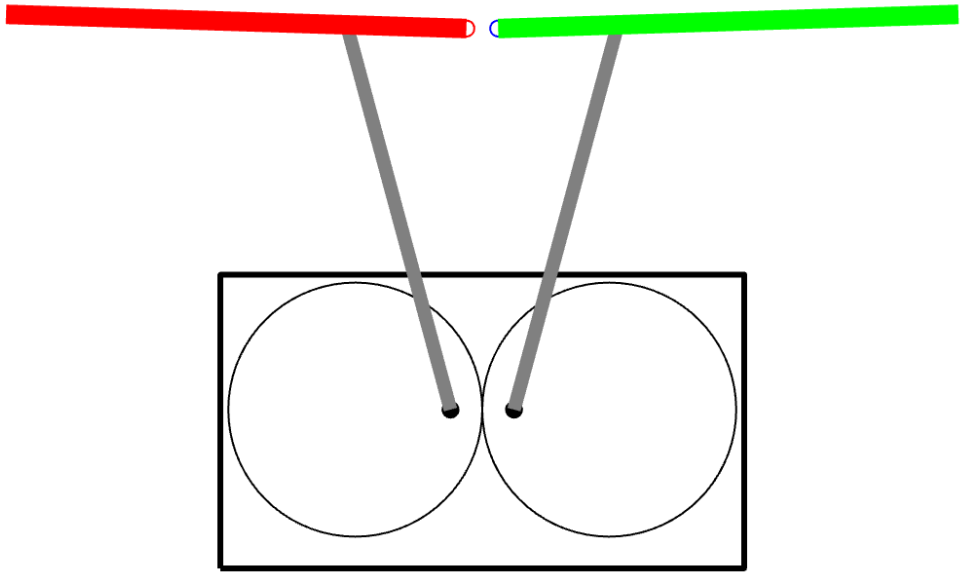
Step 3: Create Just ONE FIGURE – one frame



Step 4: Create Multiple Frames:



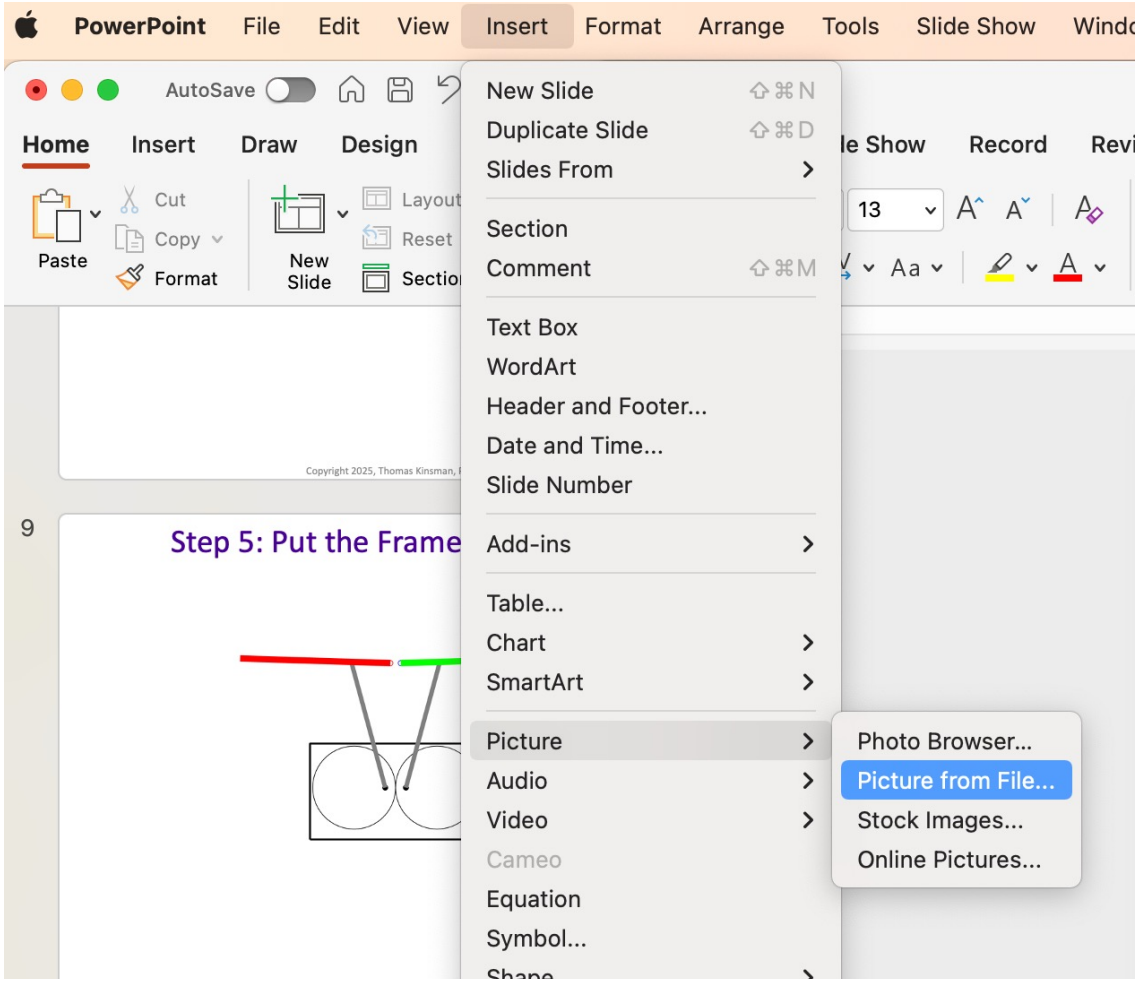
Step 5: Put the Frames Together into a GIF File



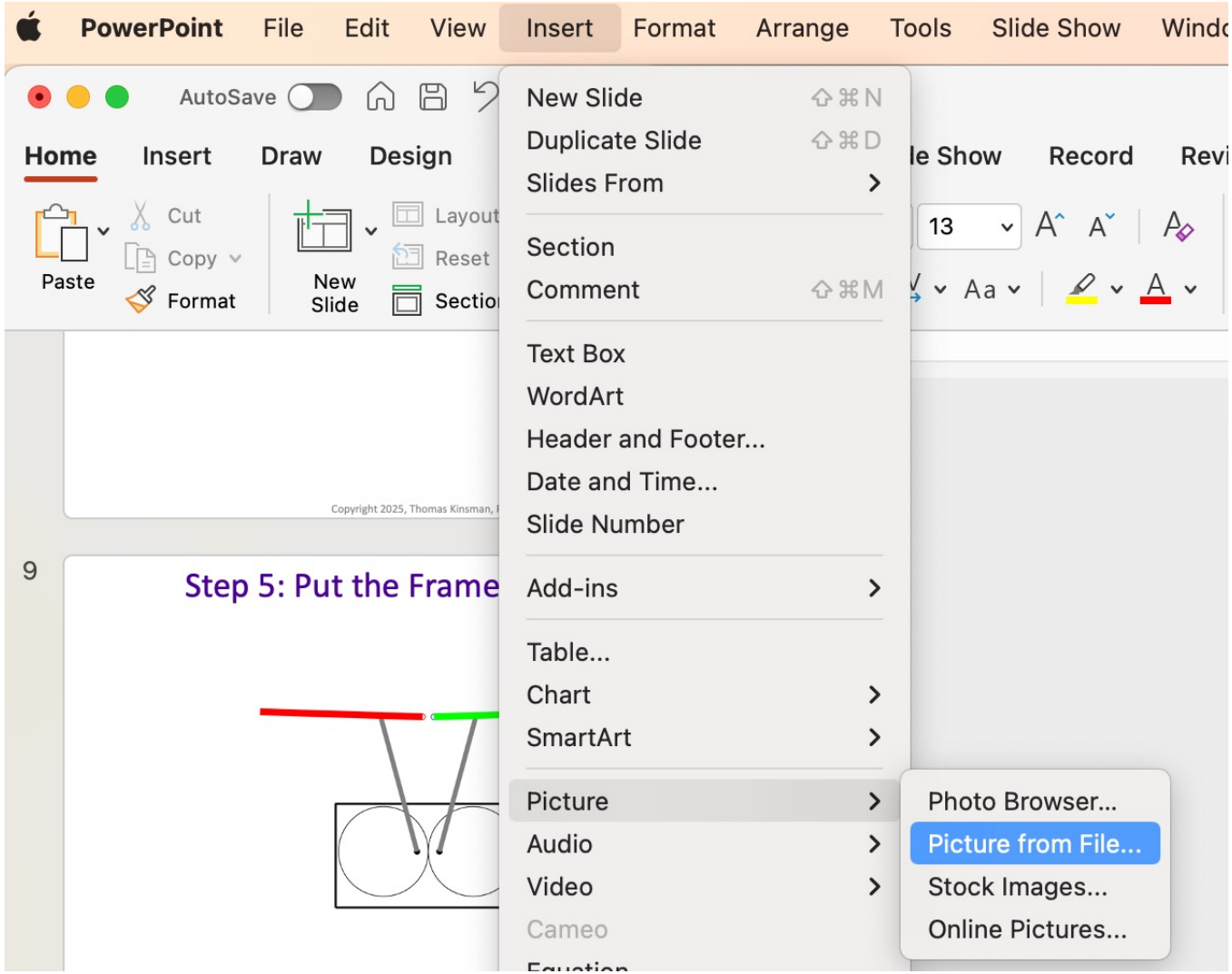
This GIF animation shows a stick-figure of a bird (or butterfly) with flapping wings.
The wings go up and down as the two wheels rotate.

Step 6: Insert a GIF Animation

- In PowerPoint:
  - Insert →
  - Picture →
  - Picture from File



Menus in PowerPoint – Zoomed in



Part B

Program Philosophy

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Program Overview – Parts

1. A sub-program that does the draws only one frame,

   for one set of parameters:

   - For one setting of the parameter or parameters

Program Overview – Parts

1. A sub-program that does the draws only one frame,
   for one set of parameters:
   - For one setting of the parameter or parameters
2. A main program that creates all frames
   - Remember the parameters are what change between frames
   - Calls the sub-program for each parameter value
   - Puts all the frames together into one file

Analogy

1. A sub-program that does which draws only one frame, depending on the one parameter:
    a. Where the motor is rotated to. (what angle?)
    b. Where the “crank” is set to.

Analogy

1. A sub-program that does which draws only one frame, depending on the one parameter:

2. A main program that turns the crank: This main program makes the motor go around. This “cranks out” the frames.

Program Overview – more details

1. draw_one_frame(parameter_value)
   given the parameter value,
   draw the figure for this value.
   Depends on where the crank is.

2. create_all_frames( ) –
   Main for parameter = 1 to 100
   a. draw_one_frame(parameter)
   b. capture that figure to memory
   c. store the memory in an output file
   d. close the program.

Part III

Examples of Animations

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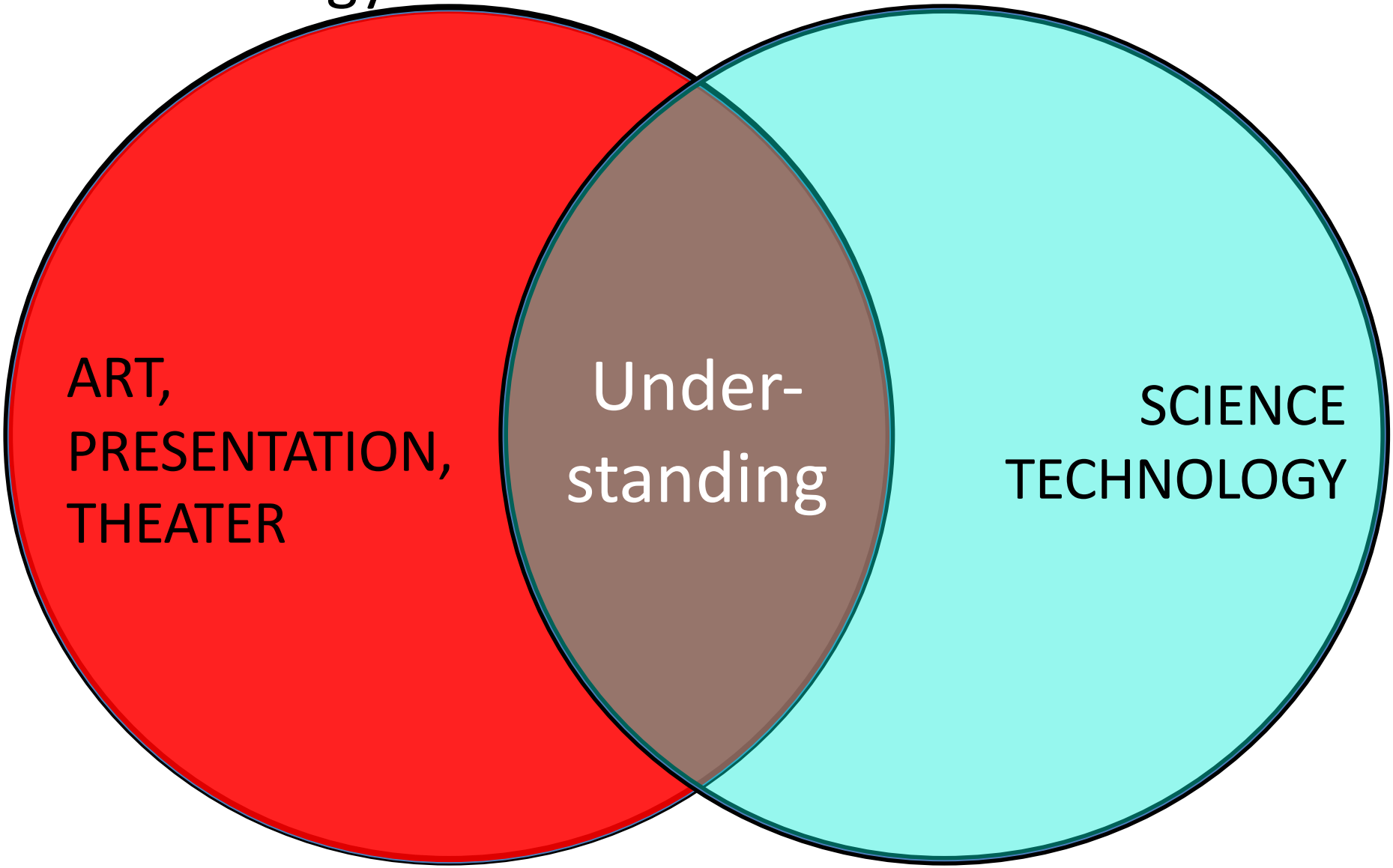
Integrating art and animation leads to:

1. Increased critical thinking abilities
2. Higher-order comprehension and deeper learning
3. Increased content mastery
4. Problem solving skills
5. Teamwork and communication skills
6. Improved visuospatial reasoning
7. General engagement and enjoyment of learning

Source: NSF / NEA AlgoArts Conference, Monday May 15th-16th, 2023

8. It saves tons of time.

- Artists benefit from knowing technology
- Engineers benefit from knowing art



Source: NSF / NEA AlgoArts Conference, 2023

Part III

Examples of Animations

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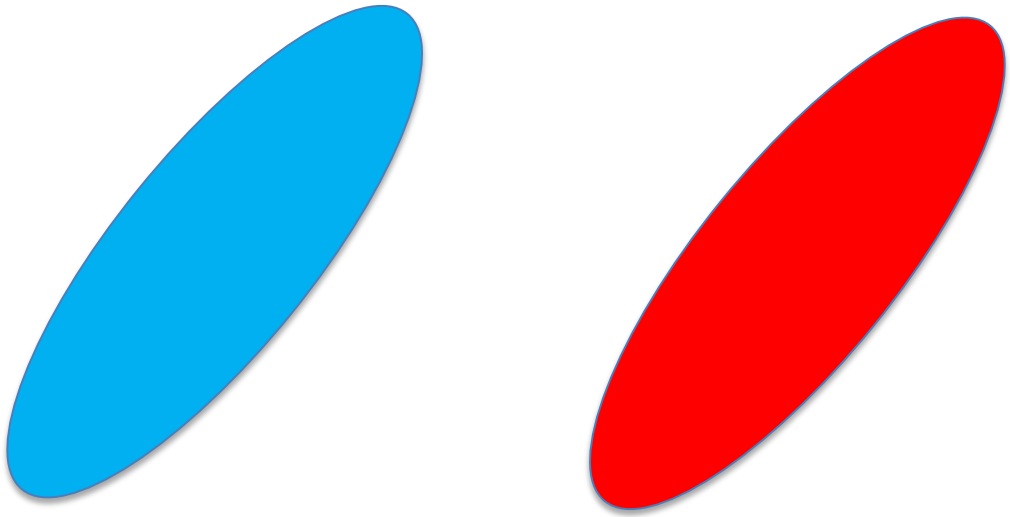
Use Native Support if Possible:

In PowerPoint I can use simple circles that are stretched and rotated to form ellipses:

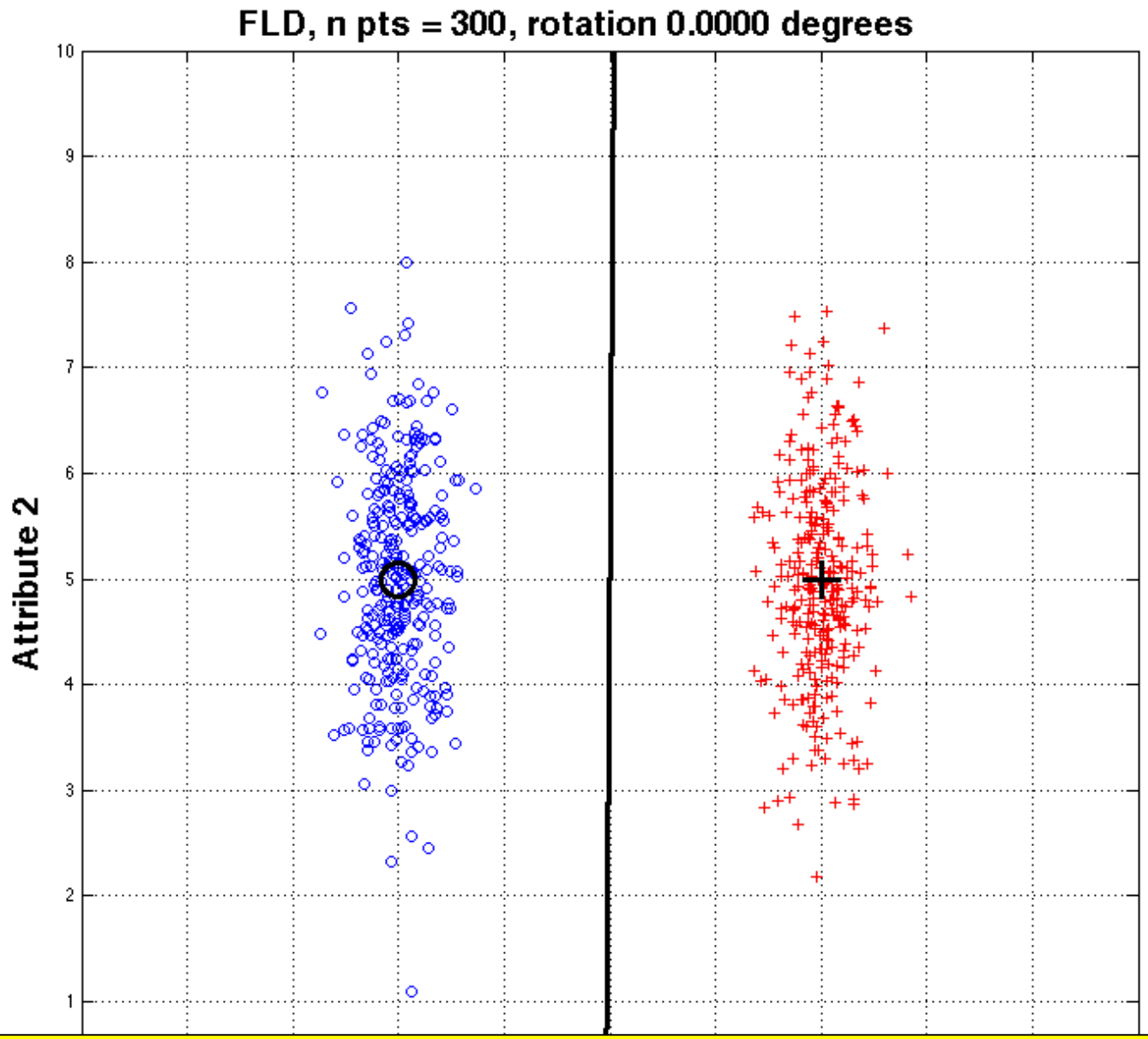


Use Red and Blue for colorblind folks

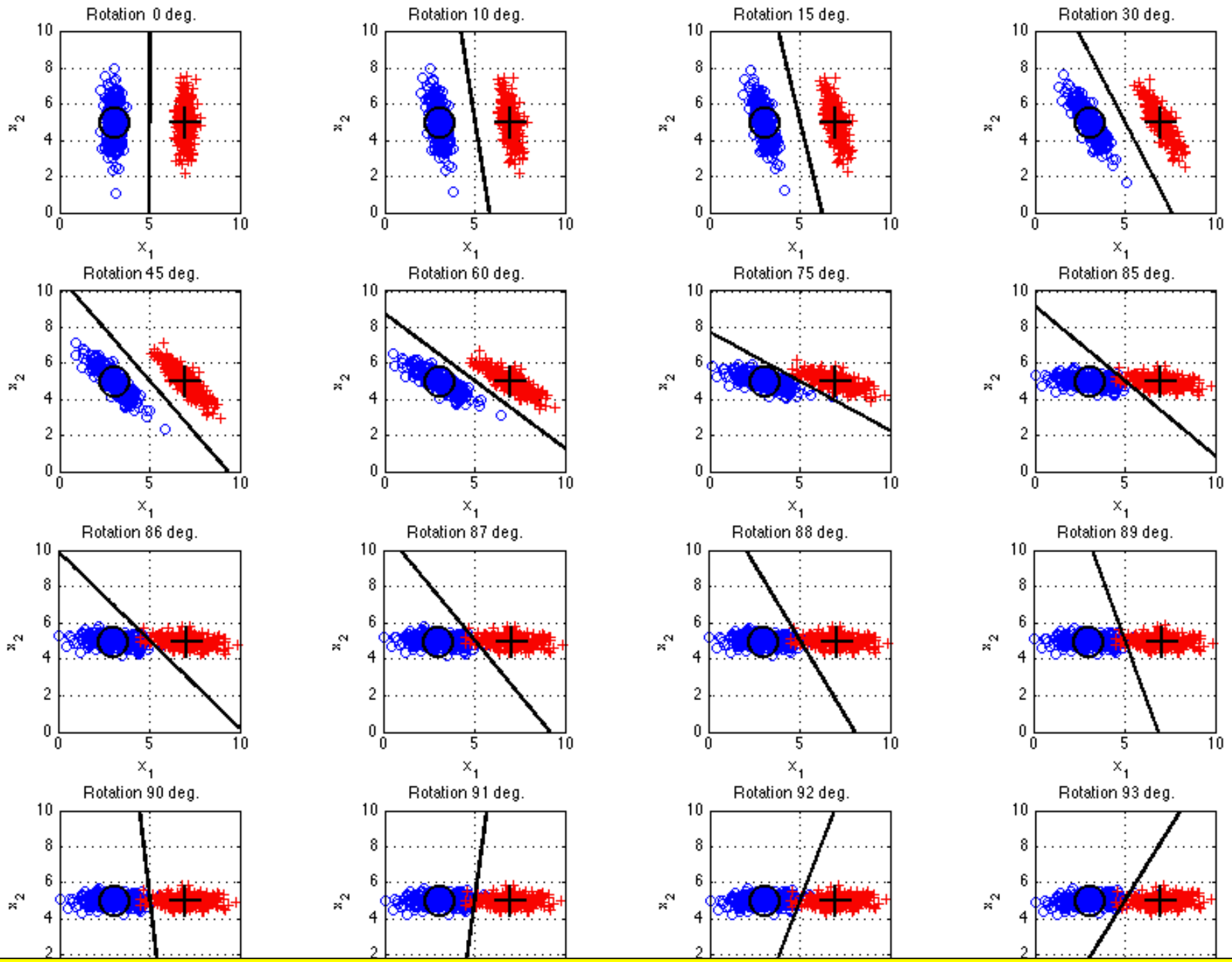
Demonstrating an Animation

- The following figures were generated using a package, one frame at a time.

- Development:
  Get things working for one frame,
  then run it for many frames.

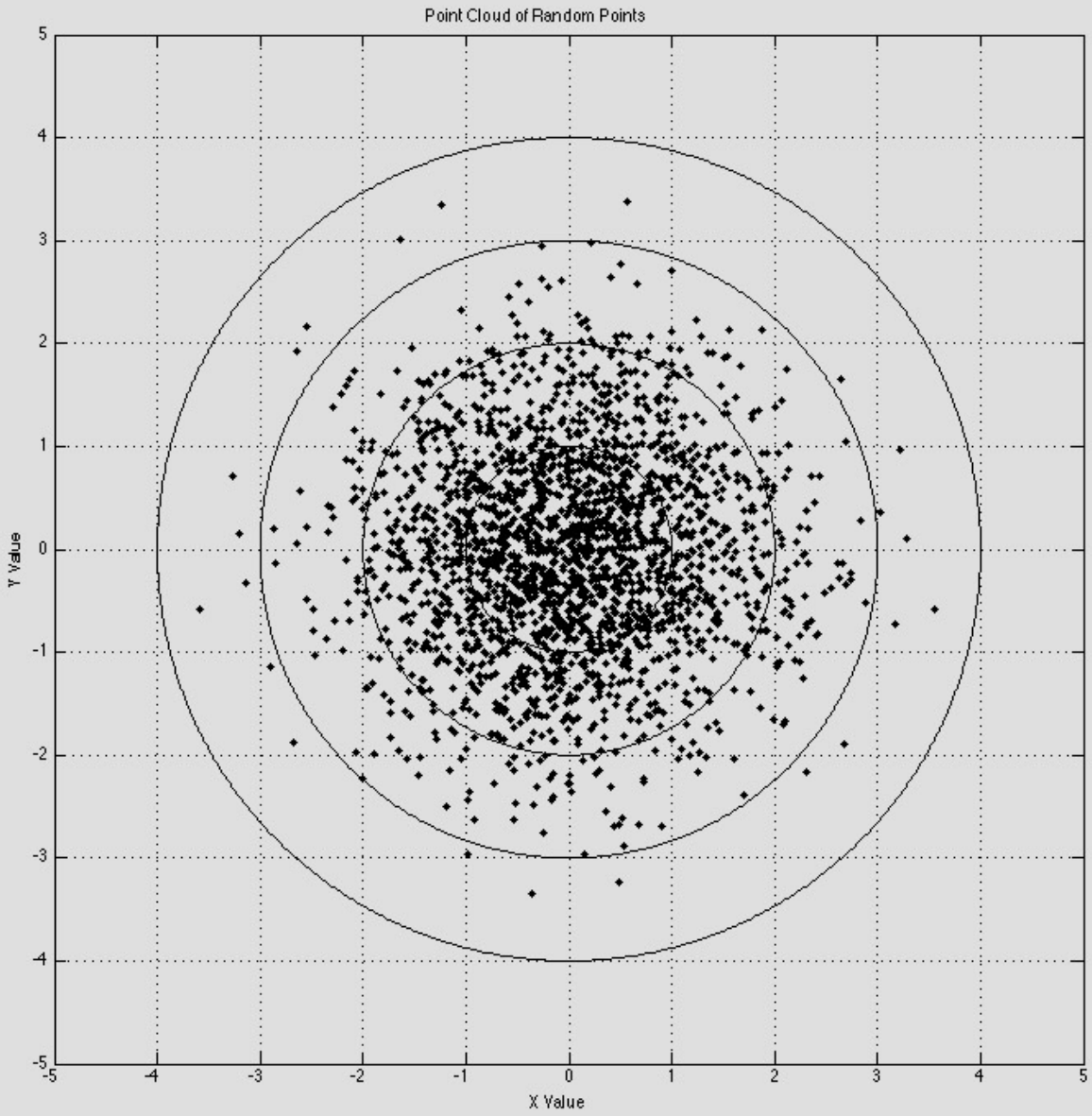


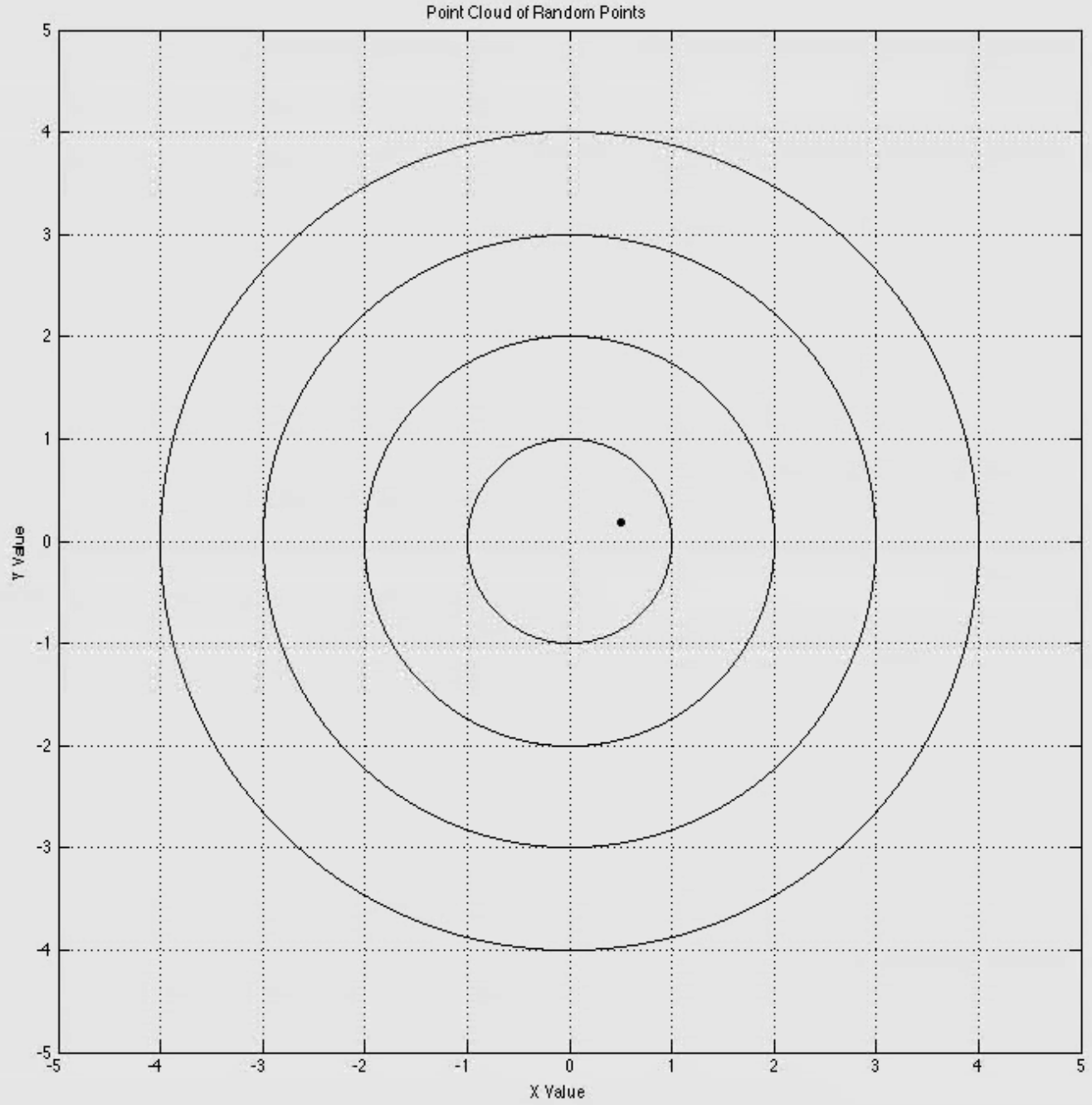
PROBLEM: 2D animations are not seen by students who only look at the PDF's.

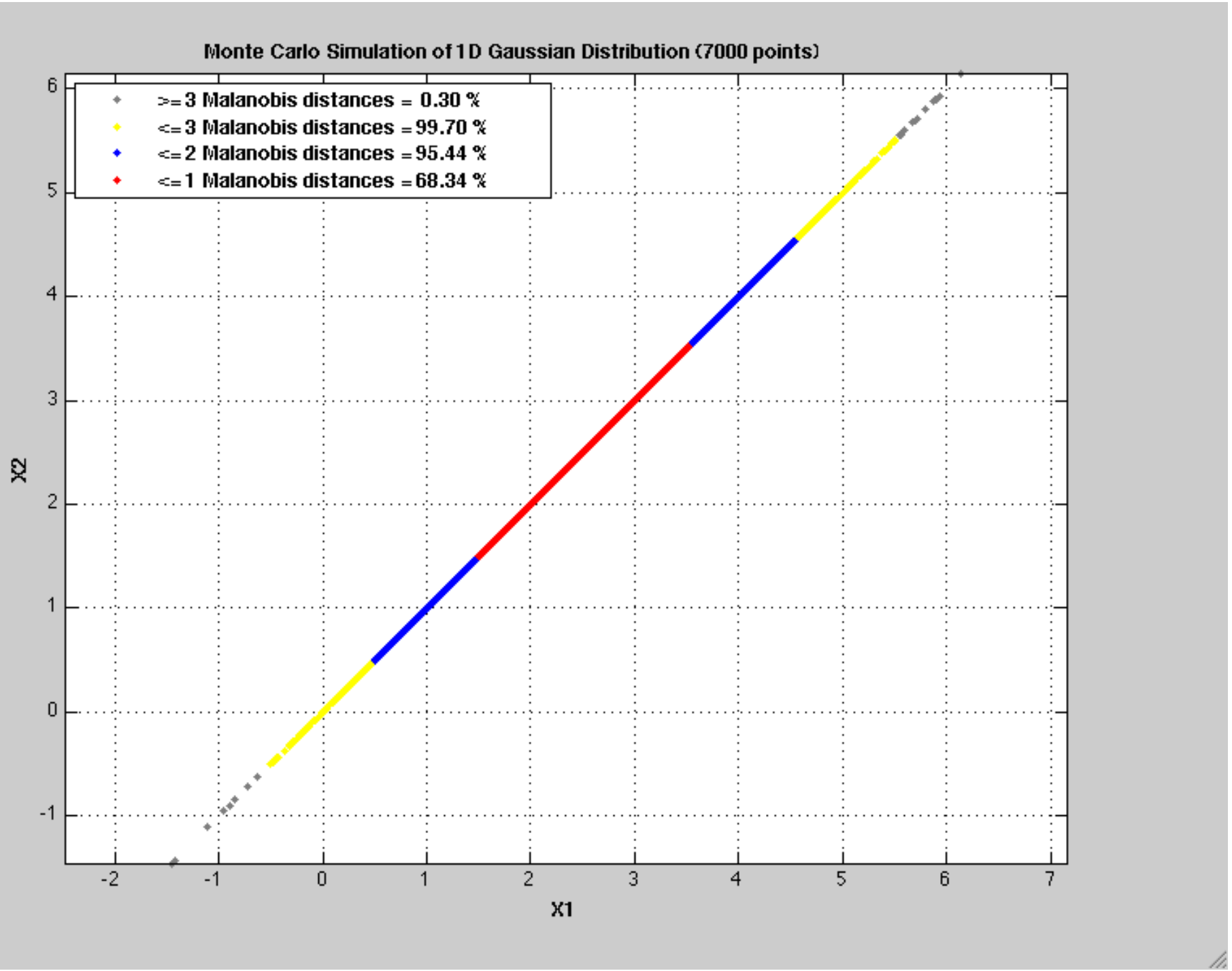


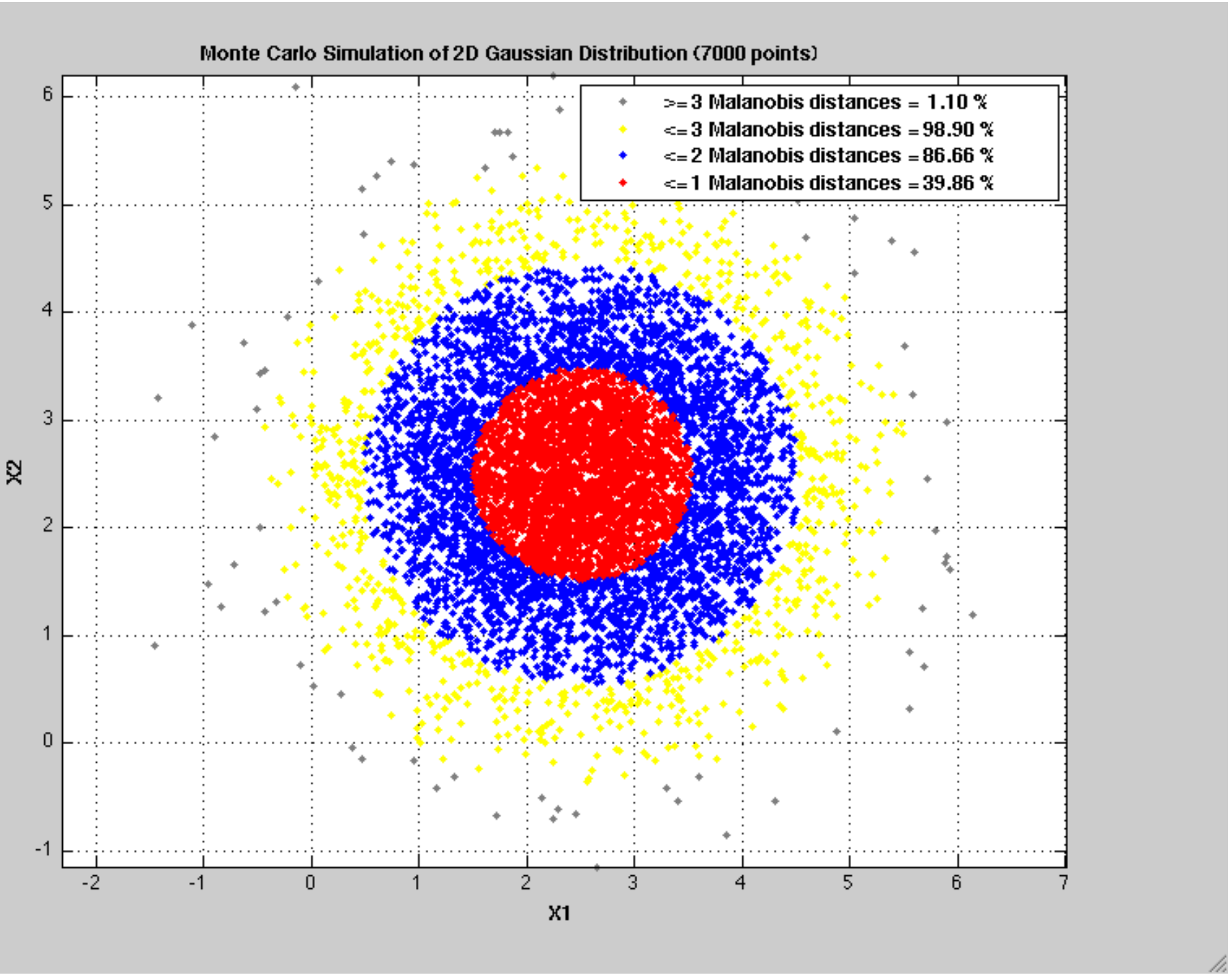
This slide shows ”key frames” from the animation for

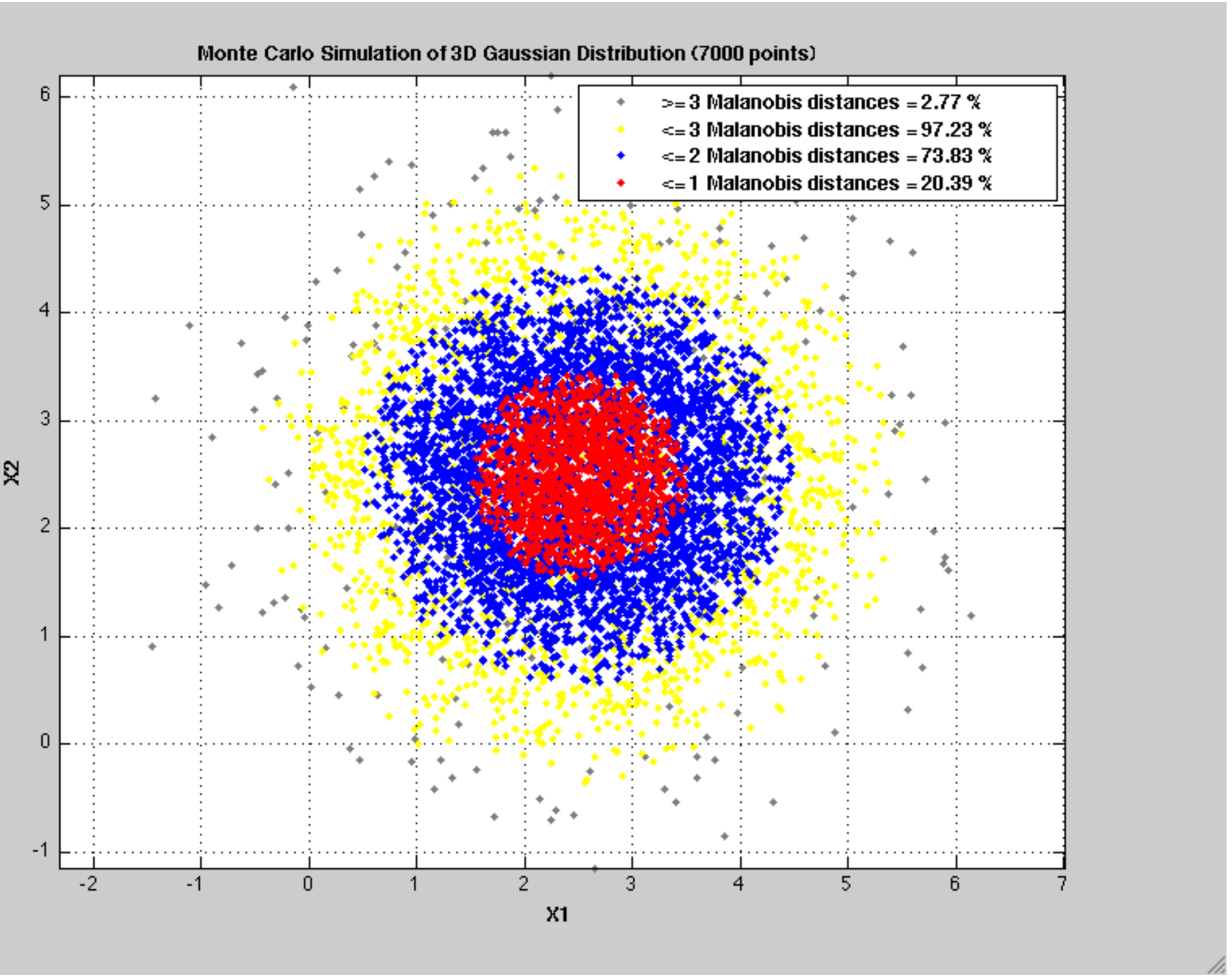
A Two-Dimensional Gaussian Distribution

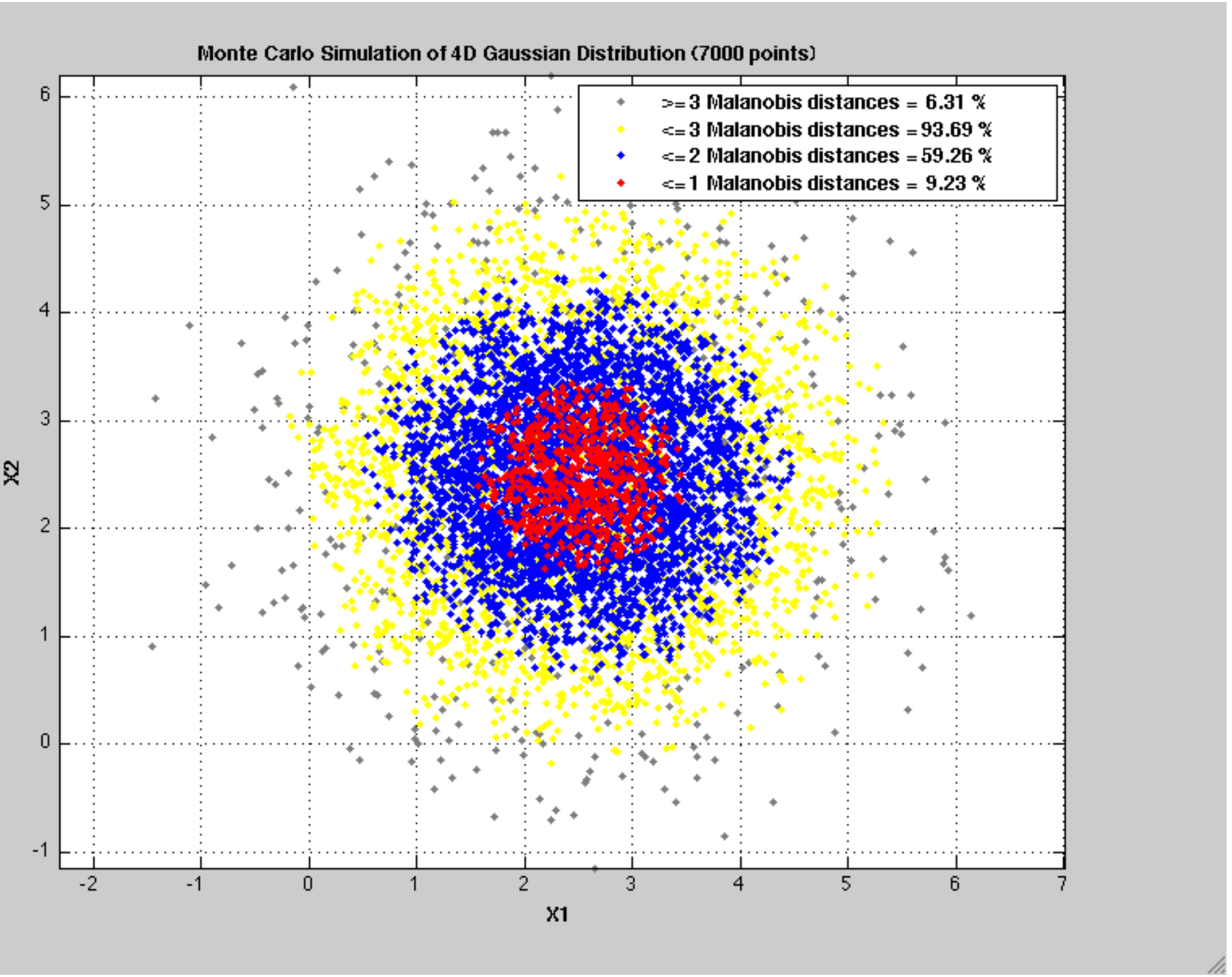


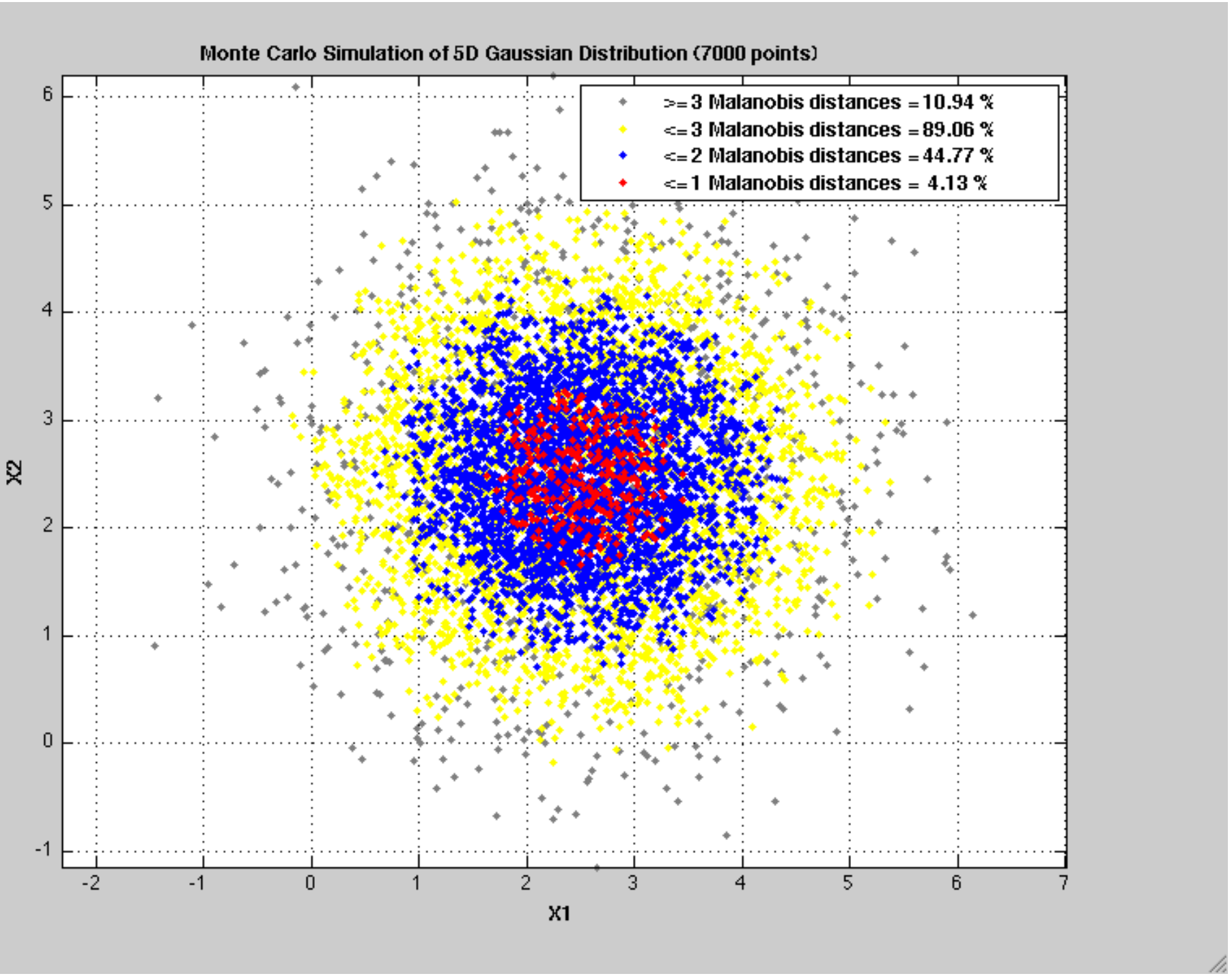

Point Cloud of Random Points
Y Value
X Value
5
4
3
2
1
0
-1
-2
-3
-4
-5
-5
-4
-3
-2
-1
0
1
2
3
4
5

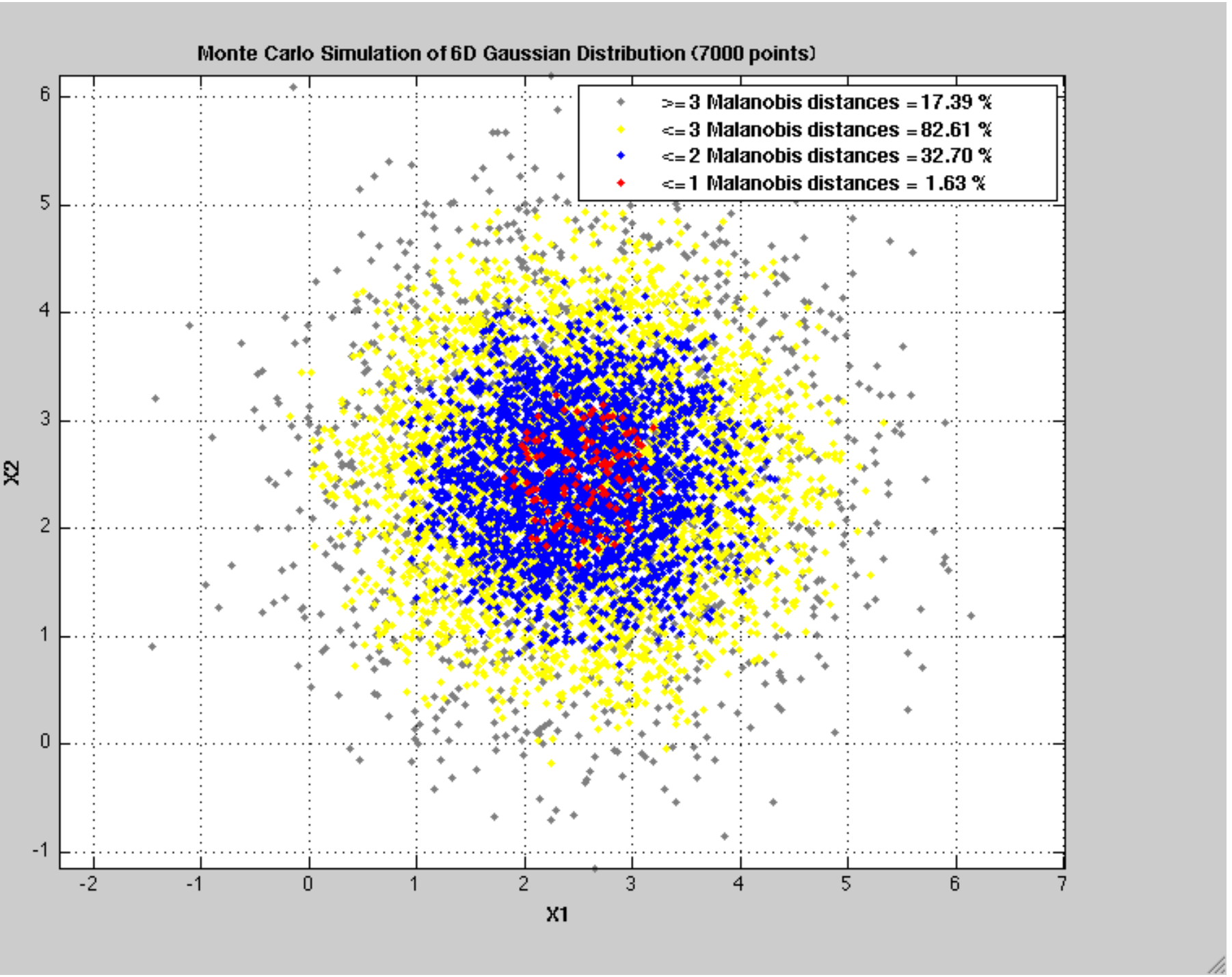

Monte Carlo Simulation of 1D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 0.30 %
<= 3 Malanobis distances = 99.70 %
<= 2 Malanobis distances = 95.44 %
<= 1 Malanobis distances = 68.34 %
X2
X1
6
5
4
3
2
1
0
-1
-2
-1
0
1
2
3
4
5
6
7


Monte Carlo Simulation of 2D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 1.10 %
<= 3 Malanobis distances = 98.90 %
<= 2 Malanobis distances = 86.66 %
<= 1 Malanobis distances = 39.86 %
X1
X2
-2
-1
0
1
2
3
4
5
6
7
-1
0
1
2
3
4
5
6


Monte Carlo Simulation of 3D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 2.77 %
<= 3 Malanobis distances = 97.23 %
<= 2 Malanobis distances = 73.83 %
<= 1 Malanobis distances = 20.39 %
X1
X2
-2
-1
0
1
2
3
4
5
6
7
-1
0
1
2
3
4
5
6


Monte Carlo Simulation of 4D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 6.31 %
<= 3 Malanobis distances = 93.69 %
<= 2 Malanobis distances = 59.26 %
<= 1 Malanobis distances = 9.23 %
X1
X2
-2
-1
0
1
2
3
4
5
6
7
-1
0
1
2
3
4
5
6


Monte Carlo Simulation of 5D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 10.94 %
<= 3 Malanobis distances = 89.06 %
<= 2 Malanobis distances = 44.77 %
<= 1 Malanobis distances = 4.13 %
X1
X2
-2
-1
0
1
2
3
4
5
6
7
-1
0
1
2
3
4
5
6


Monte Carlo Simulation of 6D Gaussian Distribution (7000 points)
>= 3 Malanobis distances = 17.39 %
<= 3 Malanobis distances = 82.61 %
<= 2 Malanobis distances = 32.70 %
<= 1 Malanobis distances = 1.63 %
X1
X2
-2
-1
0
1
2
3
4
5
6
7
-1
0
1
2
3
4
5
6

Part IV

Example of Programming in Matlab

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Installing Matlab:

- Google for:
  "Software for RIT Students site:rit.edu"
  - https://www.rit.edu/its/software-personal-computers

- On that page Ctrl-F (find) "MATLAB"
- Follow the instructions to install Matlab.
- Launch the program.

Editing Your First Program

- At the command prompt:
  - "`edit my_first_program.m`"

Getting Help:

- At the command prompt:
  - doc _____
  - help _____

- Google “How to _____ in _____”
  - “How to draw a line in Matlab?”
  - “How to create a plot in python?”

- `edit my_first_program.m`

- Name the function the name of the file:

```
function my_first_program()
   disp('commands go in here');
end
```

- Run the function at the prompt:

```
> my_first_program( )
```

Essential Matlab Commands:

1. % Comments start with a percent sign.
2. Commands end in a semicolon.
3. White space does not matter
4. For graphics
   - `plot( )`
   - `patch( )`
5. drawnow( )
6. Loops:
   - for
   - while

About me – Education

- BS-Electrical Engineering, University of Delaware
- MS-Elec. Comp. Engineering, Carnegie Mellon University
- Ph.D., Imaging Science, RIT

About me:

- **Created the first ever JPEG image at Kodak.**
- I wrote the first digital image file format converter for Eastman Kodak Company.
- TIFF – Tag Image File Format.
- I have been making computer graphics since 1972 (over fifty years).
- I have been doing computer graphics since I was in fifth grade.
- You can too.
- The “Personal Computer” did not happen until ~1979. (Apple IIe)

Switched to program demos here:

Caution:

- Students and Readers won't know the difference.
  They assume the world happens for them.
  They will not know the difference.

- Do not kill yourself.
  The extreme measures will not be rewarded…

- Unless you *point out* to them
  that they are seeing something not in the book.

Closing

- No one cannot remember what was on the last slide. Manage attention.
- Have students sketch graphs and relationships.
- There are many plotting routines to use, they are all very similar.
- It is best to get good at one for a start. Then you can dabble in others.