# L30: Discussion

## Numerical Differentiation; Numerical Integration; Project

Lucas A. J. Bastien

E7 Spring 2017, University of California at Berkeley

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Version: release

# Announcements

**Lab 11 is due on April 14 at 12 pm (noon)**

**Lab 11 is significantly shorter than most previous labs**

Use the opportunity to:

- Get a lot of points on lab 11!
- Work on your project!

**Today:**

- Numerical differentiation and integration:
  Examples and practice questions
- Project discussion, tips, and recommendations

**Next week:**

- Ordinary differential equations (Chapter 19)

# Getting help on lab assignments and on the project

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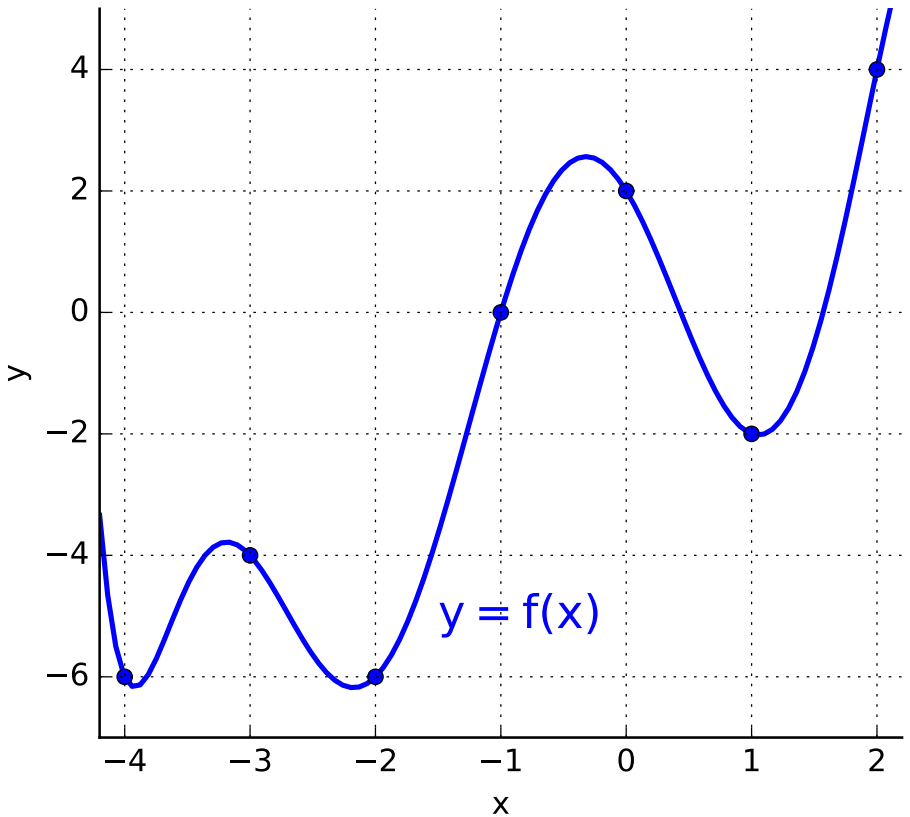
- **Friday morning lab drop-in hours**

# Numerical differentiation: practice question

What is the value of $f'(-1)$ as estimated by the backward finite-difference approximation with spacing $\Delta x = 2$?




**(A)** 1

**(B)** 2

**(C)** 6

**(D)** -1

**(E)** 3

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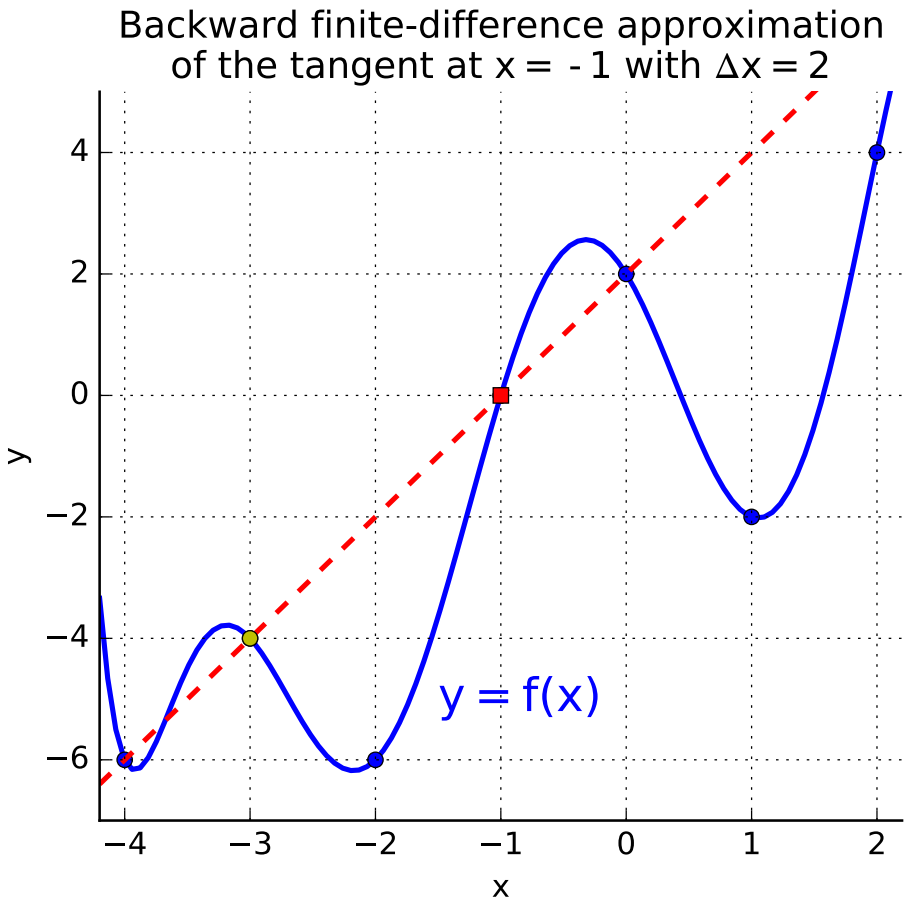


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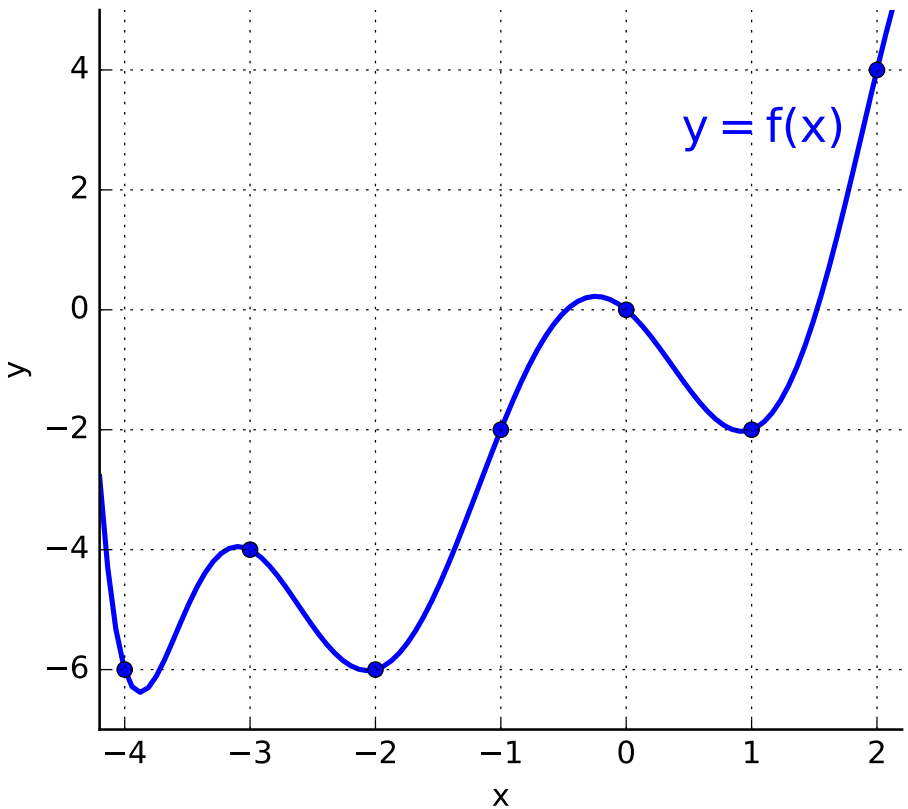
What is the value of $\int_{-4}^{0} f(x)dx$ as approximated by the midpoint formula with spacing (*i.e.* width of sub-intervals) $\Delta x = 2$?

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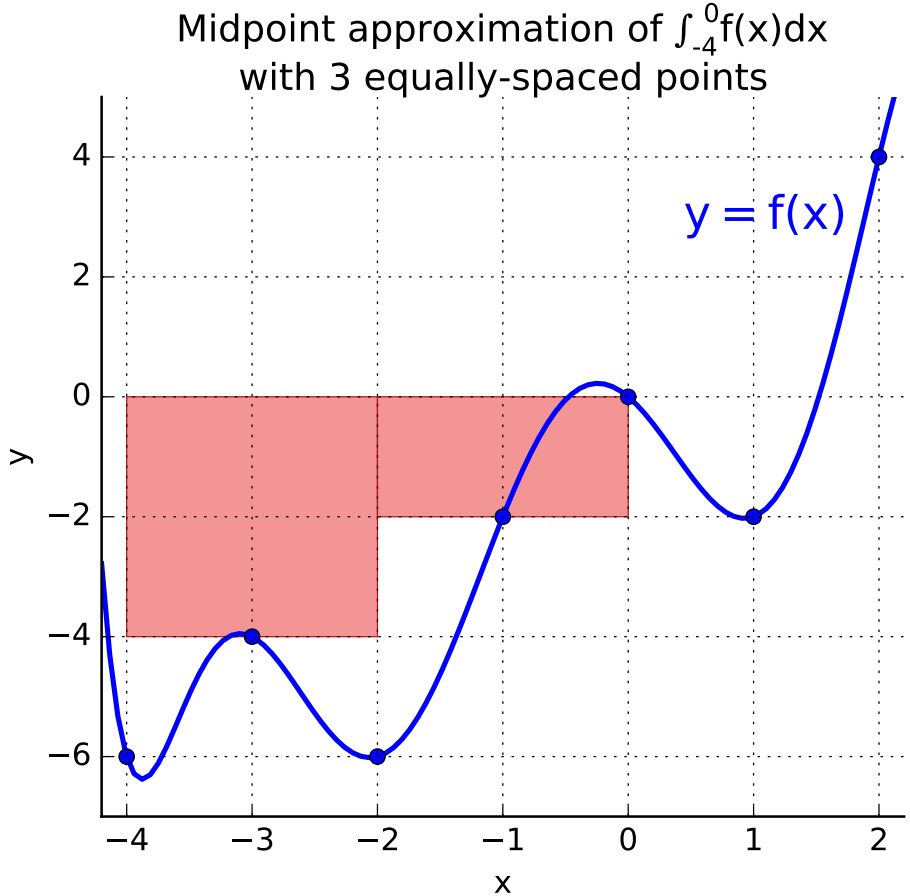


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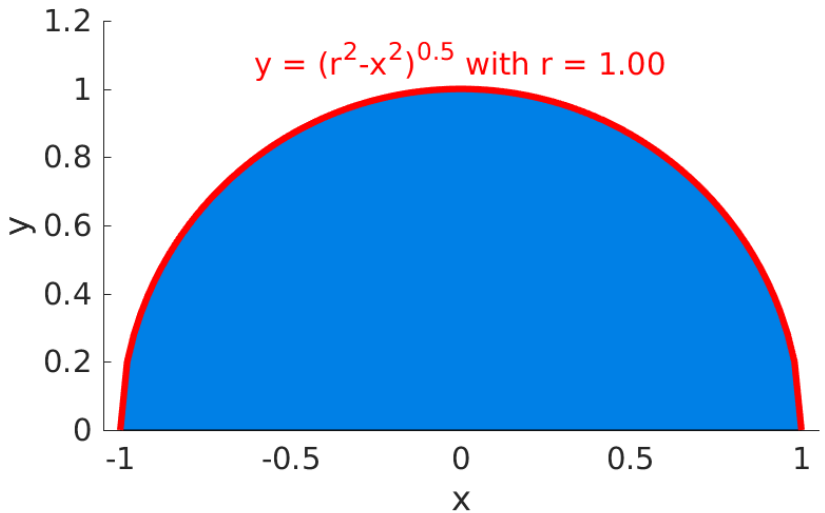
# Estimating $\pi$ using numerical integration

$$\int_{-r}^{r} \sqrt{r^2 - x^2}dx = \text{Area of half-circle of radius r} = \frac{\pi r^2}{2}$$

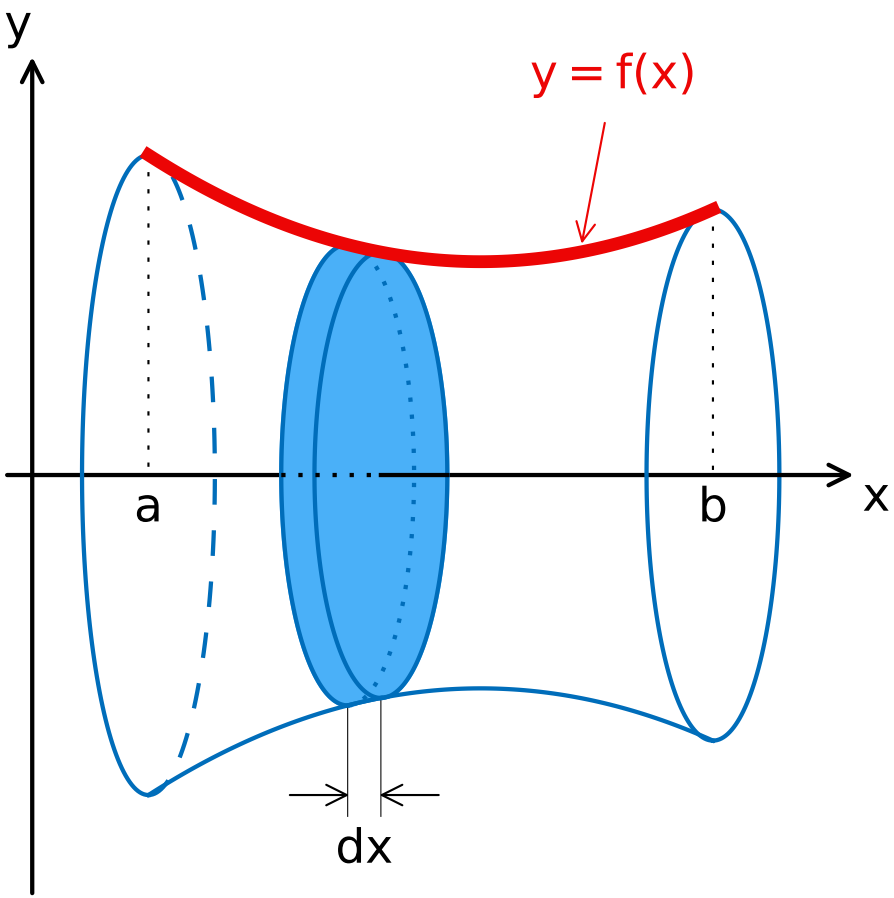



$$\pi = \frac{2}{r^2} \int_{-r}^{r} \sqrt{r^2 - x^2}dx$$

We can use numerical integration to estimate the value of the integral (see script: `estimate_pie_numerical_integration.m`)

# Volume of solids of revolution using numerical integration

**Question 3 of lab 11:** using numerical integration, estimate the volume of solids of revolution given their "profile" *i.e.* the line of equation $y = f(x)$ that is being rotated to form the solid



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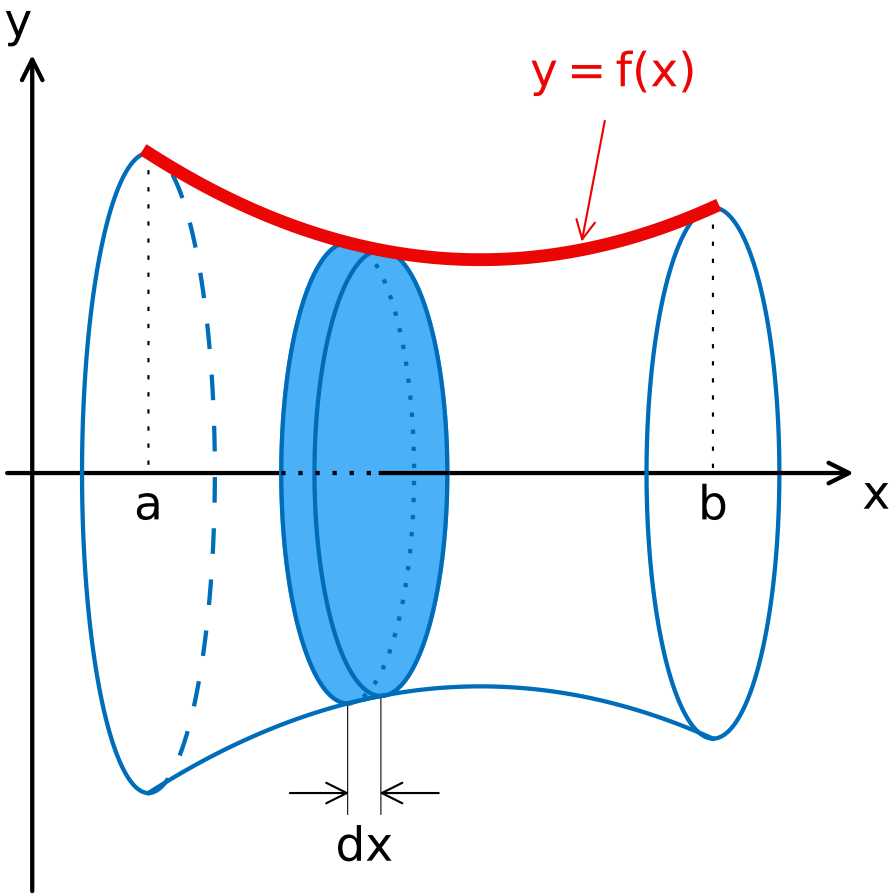


Volume of the slice of infinitesimally small width $dx$:

$$\pi f(x)^2 dx$$

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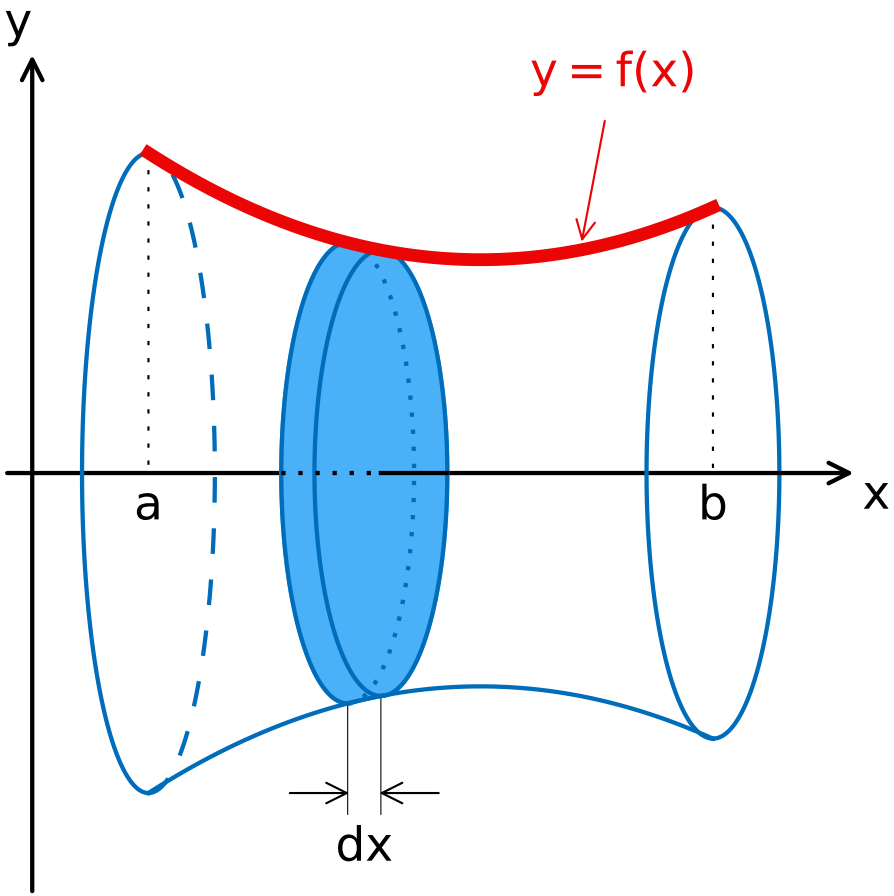


Volume of the slice of infinitesimally small width $dx$:

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Volume $V$ of the solid:

$$V = \sum \text{volume of each slice}$$
$$= \int_a^b \pi f(x)^2 dx$$

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  - Your function will be graded on three maps. Each map will have only one scrap, no impassable areas, no slow-down areas, no ghosts, and wrap-around moves will not be necessary

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- **Final write-up (15 points): due Friday April $28^{\text{th}}$ at 11:59 pm**
  - 1 to 2 pages (no more), PDF format
  - Describe the approach and algorithms that you used in your code
  - Describe in which situations your code works well, and in which situations it does not
  - You can talk about algorithms you tried or wanted to try, but did not end up using in your final code
  - Use sections, headings, and figures as appropriate to support the text

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- Divide your code in sub-functions
- Test your code at each step of the process

# Project: create your own maps

For example, see the script `create_my_map.m`, that was used to create the following map: