



Technical University of Lodz
Institute of Electronics

Algorithms and Data Structures

Introduction for Biomedical Engineering IFE Students

Łódź 2012





General Information

- Lecturers :



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https://poczta2011.p.lodz.pl/service/user/marek.kocinski@p.lodz.pl/studenci_2012.html



General Information

- **Lecture/Tutorial:** 30h (15 x 2 hours/week)
- **Venue:** room 413, building B9, Wólczańska 211/215

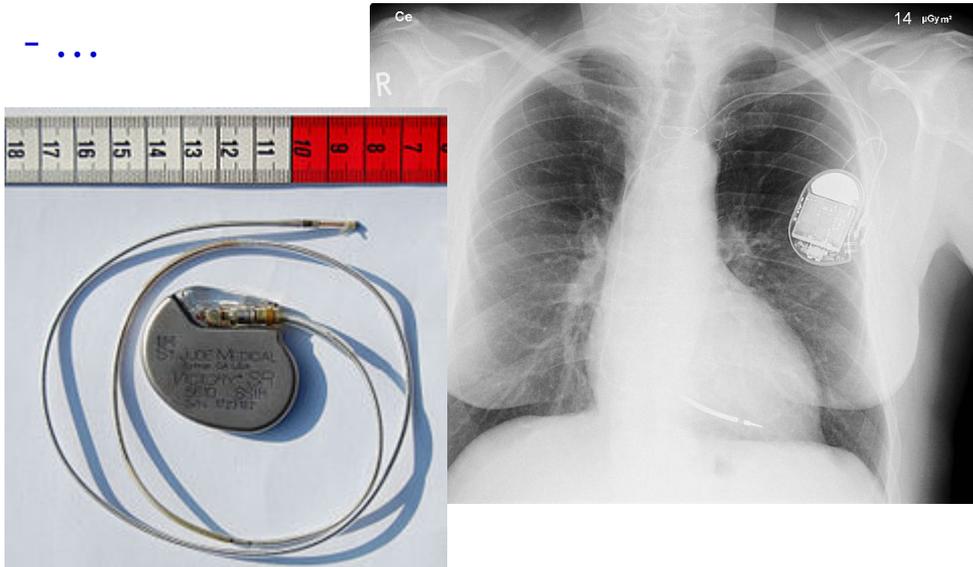
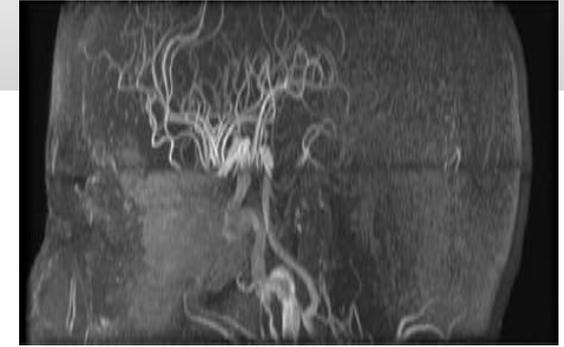
- **Credits:** 2 ECTS points (1 ECTS point = 25 - 30 h)
- **Self work:** 25 - 30 hours

- **Programming Language:** Python
- **Tools:** Enthought Python Distribution (EPD)



Computers in Medicine

- HealthCare IT Systems
- Medical Imaging (CT, MRI,...)
- Image Analysis/Segmentation
- Medical Signal Analysis
- Surgery Navigation Aids
- Pacemakers
- ...



http://en.wikipedia.org/wiki/Artificial_cardiac_pacemaker



Computers in Medicine



Laptops, Netbooks and Tablets



Desktops and Workstations



Servers, Storage and Networking



Software and Peripherals

- HealthCare IT Systems
- Medical Imaging (CT, MRI,...)
- Image Analysis/Segmentation
- Medical Signal Analysis
- Surgery Navigation Aids
- Pacemakers
- ...

<http://content.dell.com/us/en/healthcare/healthcare-solutions>



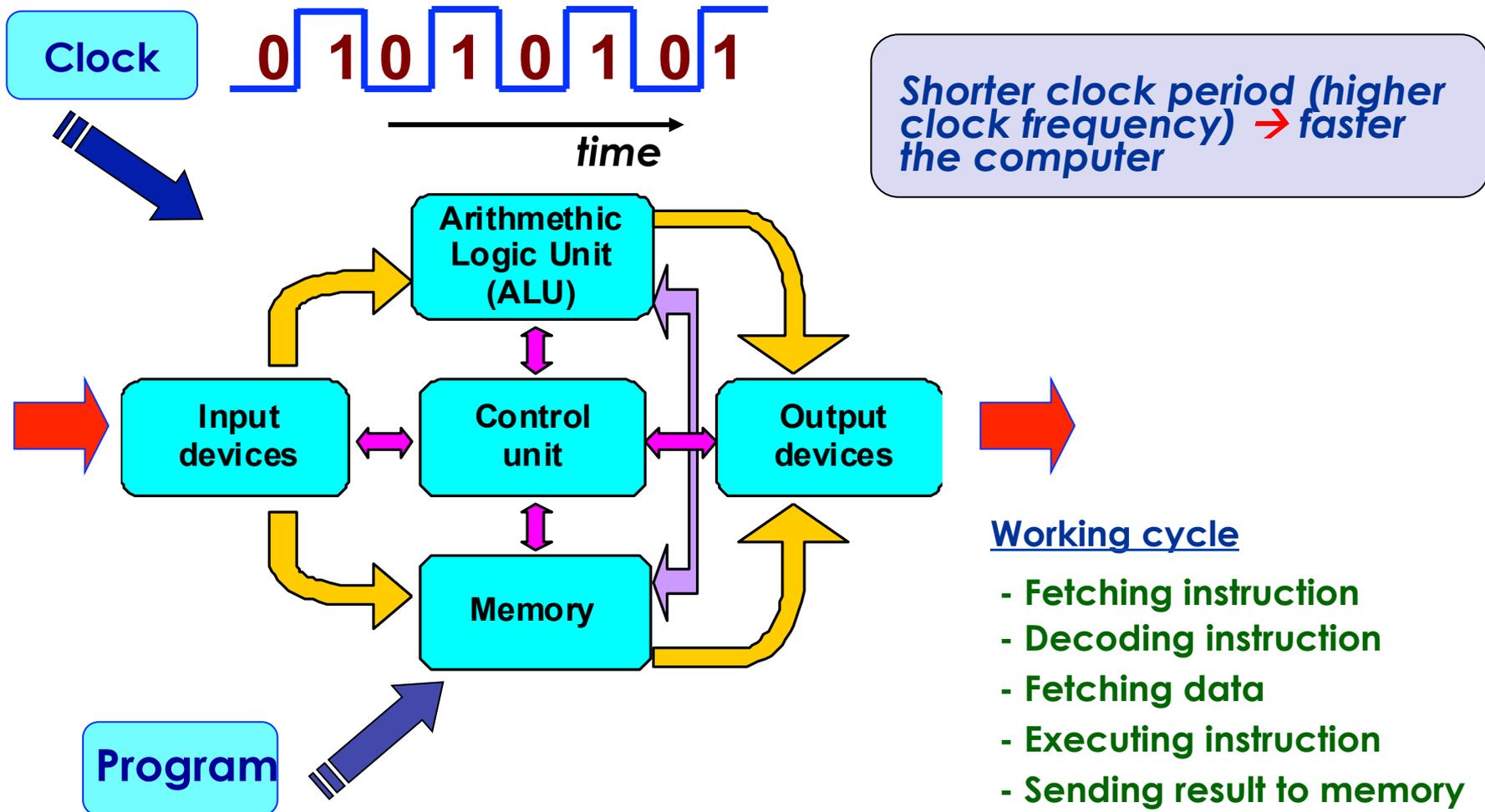
- What is a computer in those applications?
- What functions does it perform?
- Why do we use computers?





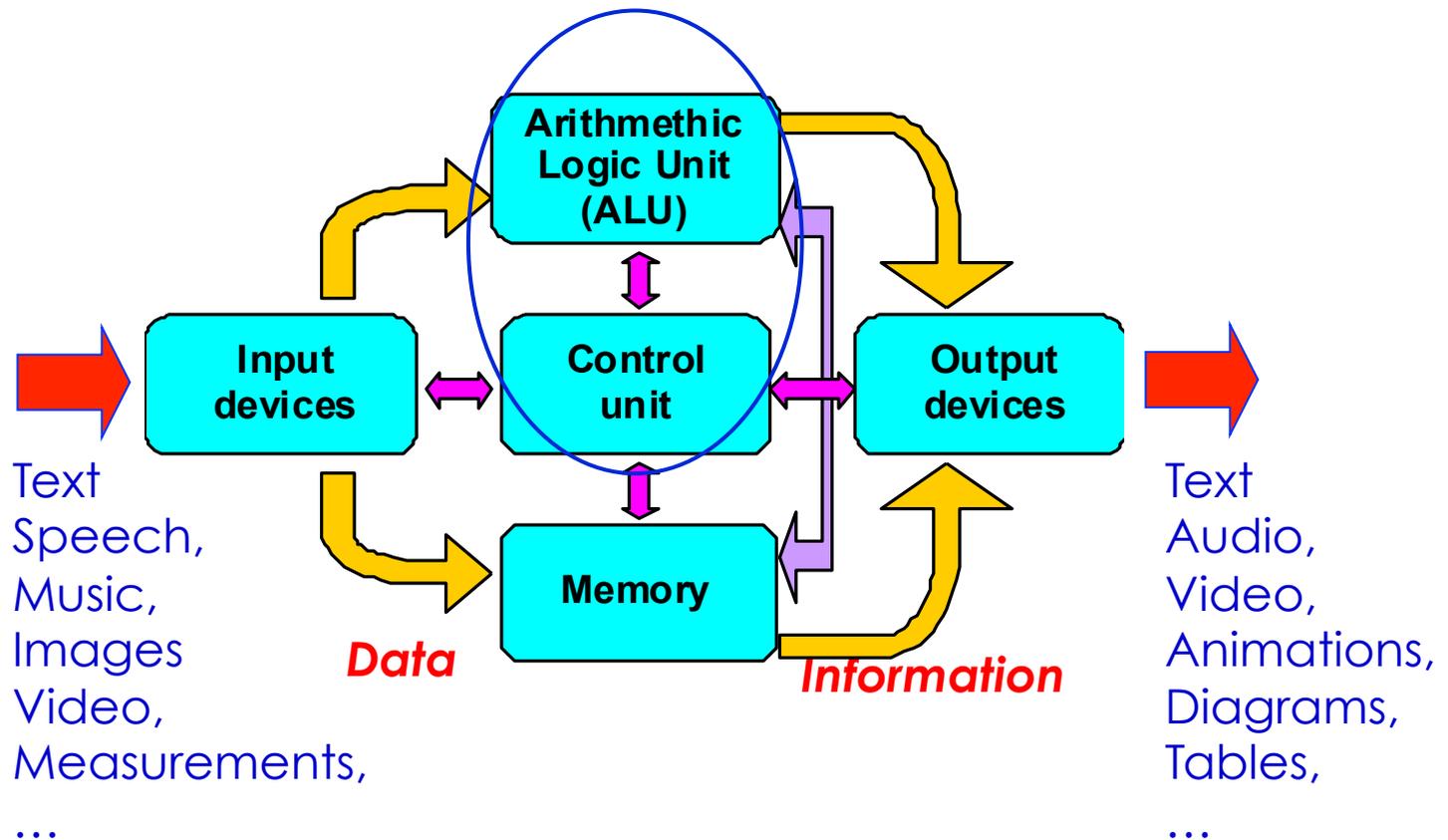
Basics of Computer Architecture

John von Neumann (1903-1957)



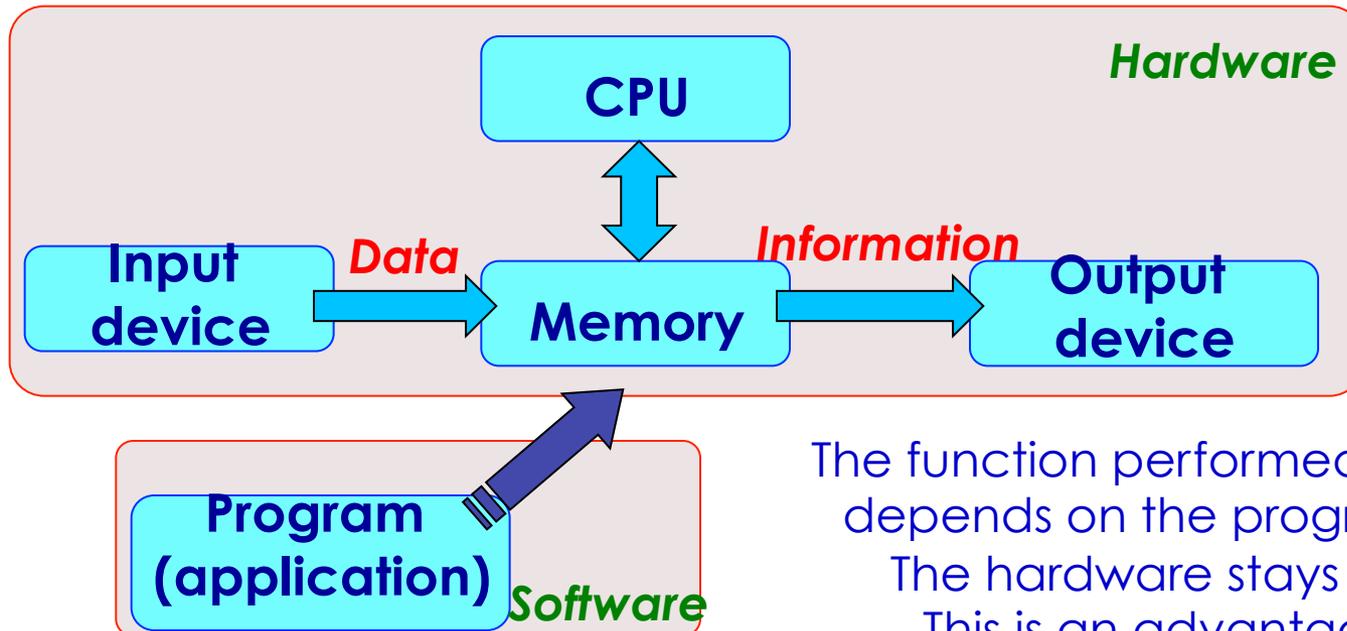
Basics of Computing

(Arithmetic Logic Unit + Control Unit) = Central Processing Unit (CPU)





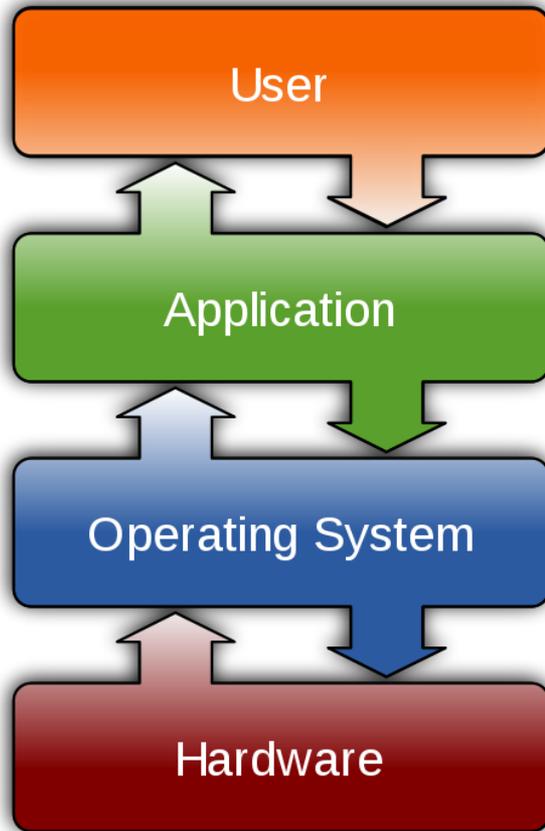
The need for programming



The function performed by a computer depends on the program (software). The hardware stays all the same. This is an advantage of digital computers (functional flexibility).



Operating system (OS)



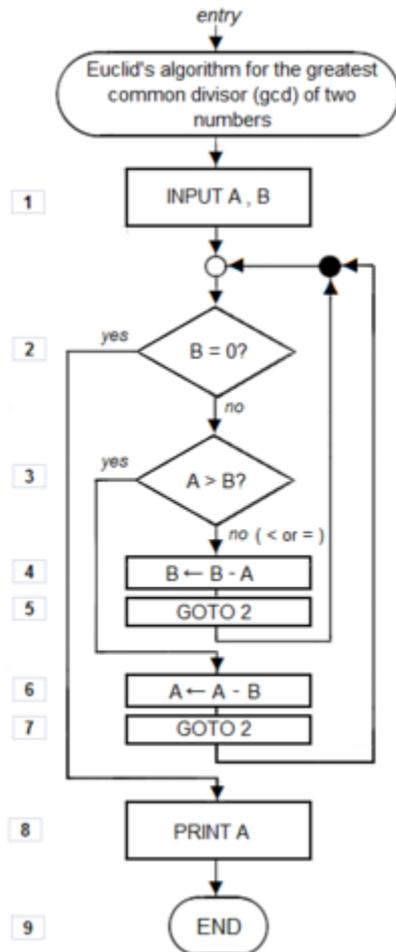
A collection of software to manage the hardware and to provide services to application programs.

OS examples: Microsoft Windows, Apple Mac OSX, Android.



Algorithm

Step-by-step procedure for calculation



Muḥammad ibn Mūsā al-Khwārizmī (Persian)



Programming languages

Generations

1. Machine code (100011 00011 01000...)
2. Assembly code →
3. Closer to human languages, compiled or assembled prior to execution (e.g. Java, C, Python, Pascal)
4. Domain-specific languages (e.g. COBOL)
5. Problem solving by using program constraints, instead of algorithms written by programmer (artificial intelligence, learning from examples).

<u>Address</u>	<u>Instruction mnemonic</u>	<u>Arguments</u>
00000000	push	ebp
00000001	mov	ebp, esp
00000003	movzx	ecx, [ebp+arg_0]
00000007	pop	ebp
00000008	movzx	dx, cl
0000000C	lea	eax, [edx+edx]
0000000F	add	eax, edx
00000011	shl	eax, 2
00000014	add	eax, edx
00000016	shr	eax, 8
00000019	sub	cl, al
0000001B	shr	cl, 1
0000001D	add	al, cl
0000001F	shr	al, 5
00000022	movzx	eax, al
00000025	ret	



Python versus assembler example

Program for printing a „Hello World” message

X86 assembly language – x86-64 Linux, AT&T syntax

```
.section      .rodata
string:
    .ascii "Hello, World!\n\0"

length:
    .quad . -string          #Dot = 'here'

.section     .text
.globl _start                #Make entry point visible to linker
_start:
    movq $4, %rax            #4=write
    movq $1, %rbx            #1=stdout
    movq $string, %rcx
    movq length, %rdx
    int $0x80                #Call Operating System
    movq %rax, %rbx          #Make program return syscall exit status
    movq $1, %rax            #1=exit
    int $0x80                #Call System Again
```



Python versus assembler example

Program for printing a „Hello World” message

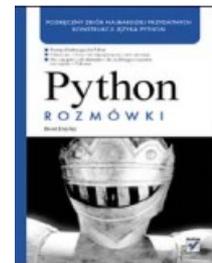
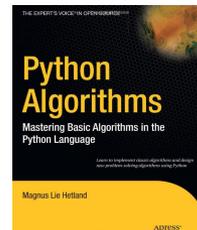
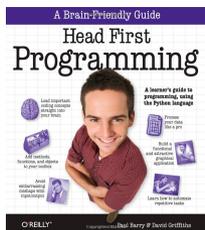
Python language

```
print "Hello World"
```



Literature

- **Head First Programming: A Learner's Guide to Programming Using the Python Language** by David Griffiths
- **Head First Python** by Paul Barry
- **Python Algorithms: Mastering Basic Algorithms in the Python Language** by Magnus Lie hetland
- **Python. Rozmówki**, Brad Dyley
- **Python od Podstaw** – zespół autorów
- **Zanurkuj w pythonie** (http://pl.wikibooks.org/wiki/Zanurkuj_w_Pythonie)
- **Programowanie z Pythonem** podręcznik stworzony dla studentów I roku neuroinformatyki I fizyki medycznej na Wydziale Fizyki Uniwersytetu Warszawskiego (http://brain.fuw.edu.pl/edu/TI:Programowanie_z_Pythonem/Wersja_do_druku)
- Many many more books and tutorials available on the Internet





Final mark

- 5 computer tests during the semester (75 %)
- Activity during classes (attendance, presentations, programming project) (25 %)



General Advice

- Slides shown during lectures do not cover all knowledge needed for passing the exam.
- Knowledge is acquired through studying and exercise.
- It is wise to take notes.
- It is worth browsing tutorials of Python modules used during classes.



Used Materials

1. Python for Scientist and Engineers – slides from course by Enthought, Inc. www.enthought.com
2. www.pl.python.org
 1. <http://pl.python.org/docs/>
 2. <http://pl.python.org/kursy,jezyka.html>
 3. <http://pl.python.org/wyklady.html>



Download and Installation of EPD

The screenshot shows the Enthought website with several elements circled in red:

- The browser address bar containing `www.enthought.com`.
- The navigation menu in the top right corner, specifically the links `www.scipy.org`, `downloads`, and `blog`.

The main content area features a large banner for **Enthought Python Distribution 7.3** with the text: "Single-click installation of Python 2.7 and 100+ libraries for scientists, engineers and analysts. Now with enaml and Shapely. Windows, Mac OS X, Linux, Solaris." A **SUBSCRIBE** button is visible below the banner.

On the left side, there are several promotional boxes:

- Enthought Python Distribution 7.3**: 100+ packages for analysis & visualization. **SUBSCRIBE**
- EPDFree 7.3**: One click installs NumPy, SciPy, IPython, matplotlib, Traits & Chaco. **DOWNLOAD**
- EuroSciPy 2012**: 8.23-27, BRUSSELS, BELGIUM
- Software Developer**: **MULTIPLE OPENINGS**
- UPCOMING LIVE TRAINING**: Python for Scientists and Engineers (Sep 10-14, Dayton, OH; Sep 10-14, London, UK)

On the right side, there are sections for **PRODUCTS** and **CONSULTING**, each with a brief description of the services offered.



Download and Installation of EPD

The screenshot shows the Enthought website's 'PRODUCTS' page. The navigation menu includes 'PRODUCTS', 'CONSULTING', 'TRAINING', 'SECTORS', 'COMPANY', and 'CONTACT US'. The 'ACADEMIC' button in the 'DOWNLOADS' section is circled in red. Below the navigation, there is a section for 'Buy a Subscription to EPD' with a table of subscription levels: BASIC, SILVER, GOLD, and PLATINUM.

	BASIC	SILVER	GOLD	PLATINUM
Price	\$199	\$180 per user	\$990 per user	Specialized pricing
License	individual license	10 license minimum	10 license minimum	structure based on enterprise budget & needs
Platforms	All platforms & architectures	Add users in increments of 10	Add users in increments of 3	
Installation	Email installation	Phone & email	Phone & email	Custom phone/email



Download and Installation of EPD

ENTHOUGHT
SCIENTIFIC COMPUTING SOLUTIONS

EPD repository | code.enthought.com | www.scipy.org | downloads | blog

PRODUCTS | CONSULTING | TRAINING | SECTORS | COMPANY | CONTACT US

PRODUCTS

- Overview
- Enthought Python Distribution
- Support Levels
- Purchase/Download**
- Package Index
- FAQ
- Getting Started
- License
- Repository
- Changelog
- EPDFree
- Upgrade
- Open Source Products

**Focus on the forest...
Leave the trees to us.**

Enthought Python Distribution Academic Download

The academic version of EPD is a fully functional installation of the software that can be used indefinitely by students and employees at degree-granting institutions. See [academic license terms](#) for details.

To download epd-7.3-1, please enter your **academic email address** below. A download link will be sent to the address you provide. For details on this release, see [EPD release notes](#).

ACADEMIC E-MAIL

EPD FOR PPC

For a OSX 10.4 Intel/PPC-compatible version of EPD, please submit your academic email address below. A download link will be sent to the address you provide.

ACADEMIC E-MAIL

SCIENTIFIC COMPUTING SOLUTIONS

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