

# Self-organizing Scientific Databases and Related Applications in Automated Development of Online Assignments

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Computer Science, and Computational Sciences  
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# Outline

- 1 Online Learning
- 2 Scientific Information
- 3 Autonomous Systems
- 4 Conclusions

# Online Learning

Online  
Learning

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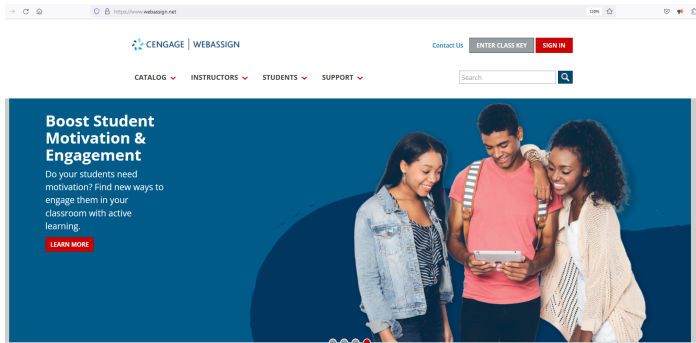


Figure: Webassign

# WebAssign

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1. 0/7.69 points

LarCalc11 7.1.006. [3865162]

Write a definite integral that represents the area of the region. (Do not evaluate the integral.)

$$y_1 = x^2 + 2x + 4$$

$$y_2 = 2x + 20$$

$$\int_{-4}^{\boxed{4}} \left( \boxed{4} - \boxed{16 - x^2} \right) dx$$

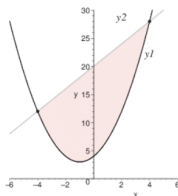


Figure: Sample assignment

# Moodle

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Figure: Online learning platform

# Online Learning

Online Learning

Scientific Information

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**Blackboard**

**HELP**

Enter Blackboard Central's virtual office | Mon - Fri 8AM - 5PM

24/7 Blackboard Support | 915-747-HELP option # 2

Blackboard Help Website

Provide your Blackboard feedback

**Technology Support Helpdesk**

MON-THU 7AM-9PM   FRI 7AM-8PM   SAT 9AM-2PM   SUN 12PM-5PM
Visit us at <a href="https://helpdesk.utep.edu">helpdesk.utep.edu</a>
Submit a request
Chat with us
Contact us: 915-747-HELP, <a href="mailto:helpdesk@utep.edu">helpdesk@utep.edu</a>

**TECHNOLOGY Support**

Figure: Blackboard

# WebWork

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The screenshot displays the WeBWorK web interface. At the top, the WeBWorK logo is on the left, and the user is logged in as a student with a 'Log Out' link on the right. Below the header, a navigation bar shows the path 'WeBWorK → TestCourse → HW3 → 1'. The main content area is titled 'HW3: Problem 1' and shows a problem worth 1 point. The problem asks for a function  $F(x)$  such that  $F'(x) = \int x^5 \cos(x^6) dx$ . The user is prompted to 'Give a specific function for  $F(x)$ ' and a text input field is provided. Below this, the user is asked to 'Evaluate'  $F(x) = \int_{-1}^4 x^5 \cos(x^6) dx$ , with another text input field. On the left sidebar, there is a 'Main Menu' with links to Courses, Homework Sets (selected), Problem 1, Password/Email, Grades, and Report bugs. Below this is a 'Problems' list with links to Problem 1 through Problem 7. At the bottom of the sidebar is a 'Display Options' section with radio buttons for 'plainText', 'formattedText', 'images' (selected), 'jsMath', 'asciimath', and 'LaTeXMathML'. There is also a 'Show saved answers?' section with 'Yes' selected and 'No' as an option, and an 'Apply Options' button. At the bottom right, there are buttons for 'Preview Answers', 'Submit Answers', and 'Email instructor'. A status message indicates 'You have attempted this problem 0 times. You have unlimited attempts remaining.' The footer contains page generation information and copyright details.

WebWork

Logged in as student.  
[Log Out](#)

WebWork → TestCourse → HW3 → 1

▲ Prob. List   Next ►

### HW3: Problem 1

(1 pt) Find

$$F(x) = \int x^5 \cos(x^6) dx$$

Give a specific function for  $F(x)$

$F(x) =$

Evaluate

$$F(x) = \int_{-1}^4 x^5 \cos(x^6) dx$$

[Preview Answers](#)   [Submit Answers](#)

You have attempted this problem 0 times.  
You have unlimited attempts remaining.

[Email instructor](#)

Page generated at 10:35am on May 12, 2008  
WeBWorK © 2000-2006 [The WeBWorK Project](#)

**Main Menu**

- Courses
- Homework Sets**
  - HW3
    - Problem 1**
- Password/Email
- Grades
- Report bugs

**Problems**

- [Problem 1](#)
- [Problem 2](#)
- [Problem 3](#)
- [Problem 4](#)
- [Problem 5](#)
- [Problem 6](#)
- [Problem 7](#)

**Display Options**

View equations as:

- ☐ plainText
- ☐ formattedText
- ☒ images
- ☐ jsMath
- ☐ asciimath
- ☐ LaTeXMathML

Show saved answers?

☒ Yes   ☐ No

[Apply Options](#)

Figure: Sample assignment

# Online Learning

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## User Main Page

	Logoff
Username:	80080081
First Name:	Pownuk
Last Name:	Andrew
Group:	2020-Fall-MATH-1312-CRN-12219
	Change password
	Change e-mail

Show my grades

Files (notes, syllabus etc.)

Figure: General information about a student



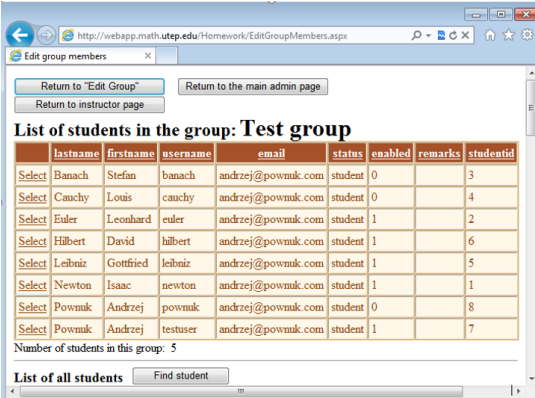
# Sample Database

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The screenshot shows a web browser window with the address bar displaying `http://webapp.math.utep.edu/Homework/EditGroupMembers.aspx`. The page title is "Edit group members". At the top, there are three buttons: "Return to 'Edit Group'", "Return to the main admin page", and "Return to instructor page". Below these buttons is the heading "List of students in the group: Test group". Under the heading is a table with 9 columns: `Select`, `lastname`, `firstname`, `username`, `email`, `status`, `enabled`, `remarks`, and `studentid`. The table contains 8 rows of student data. Below the table, it says "Number of students in this group: 5". At the bottom, there is a section titled "List of all students" with a "Find student" button and a search input field.

Select	lastname	firstname	username	email	status	enabled	remarks	studentid
Select	Banach	Stefan	banach	andrzej@pownuk.com	student	0		3
Select	Cauchy	Louis	cauchy	andrzej@pownuk.com	student	0		4
Select	Euler	Leonhard	euler	andrzej@pownuk.com	student	1		2
Select	Hilbert	David	hilbert	andrzej@pownuk.com	student	1		6
Select	Leibniz	Gottfried	leibniz	andrzej@pownuk.com	student	1		5
Select	Newton	Isaac	newton	andrzej@pownuk.com	student	1		1
Select	Pownuk	Andrzej	pownuk	andrzej@pownuk.com	student	0		8
Select	Pownuk	Andrzej	testuser	andrzej@pownuk.com	student	1		7

Number of students in this group: 5

List of all students Find student

Figure: Database of students

# Information About Particular Student

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The screenshot shows a web browser window with the address bar displaying `http://webapp.mathstep.edu/homework/Edit`. The page title is "Edit Student Membership". At the top, there are two buttons: "Return to the edit student page" and "Return to edit group". Below these, the student's information is displayed: Username: newton, Lastname: Newton, and Firstname: Isaac. A table follows, showing group information. The table has columns: group\_name, group\_ID, enabled, studentid, and status. The first row shows "Test group", "6", "1", "1", and "student". Below the table, a note states "(enabled = 0) = (user is not enabled)". Under the heading "Global user information", there is a table with fields: lastname (Newton), firstname (Isaac), member800, username (newton), password (Newton123214341), email (andrzej@pownuk.com), first\_login (0), remarks, and enabled. An "Edit" link is at the bottom of this section, followed by the note "(enabled = no) = (user is not enabled in the whole system)".

Return to the edit student page  
Return to edit group

Username: newton  
Lastname: Newton  
Firstname: Isaac

	group_name	group_ID	enabled	studentid	status
Edit Select	Test group	6	1	1	student

(enabled = 0) = (user is not enabled)

**Global user information**

lastname	Newton
firstname	Isaac
member800	
username	newton
password	Newton123214341
email	andrzej@pownuk.com
first_login	0
remarks	
enabled	

Edit  
(enabled = no) = (user is not enabled in the whole system)

Figure: Database of students

# Online Homework

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The screenshot shows a web browser window with the URL `http://webapp.math.utep.edu/Homework/EditHomeworkList.aspx`. The browser displays a table of homework assignments with columns for an ID, a description, and a file path. The table contains 10 rows of data, with the last row (ID 50) highlighted. Below the table, there is a section titled "Find the Laurent series for" with the function  $f(z) = \frac{\sin(2z)}{z^2}$  and the point  $z_0 = 0$ . Below this, there are input fields for the coefficients  $a_{-1}$  and  $a_0$ , and a button labeled "Calculate and submit grade".

ID	Description	File Path
42	TG-Homework-2	./HomeworkDir/TG-Homework-2.aspx
43	Cal-III-Homework-13	./HomeworkDir/Cal-III-Homework-13.aspx
44	Cal-II-Homework-12	./HomeworkDir/Cal-II-Homework-12.aspx
45	AA-I-Homework-12	./HomeworkDir/AA-I-Homework-12.aspx
46	Cal-III-Homework-14	./HomeworkDir/Cal-III-Homework-14.aspx
47	Cal-II-Homework-13	./HomeworkDir/Cal-II-Homework-13.aspx
48	AA-I-Homework-13	./HomeworkDir/AA-I-Homework-13.aspx
49	AA-I-Homework-14	./HomeworkDir/AA-I-Homework-14.aspx
50	AA-I-Homework-15	./HomeworkDir/AA-I-Homework-15.aspx

Find the Laurent series for

$$f(z) = \frac{\sin(2z)}{z^2}$$

at  $z_0 = 0$

$a_{-1} =$

$a_0 =$

Figure: Database of homework assignments

# Online Homework

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Calculate the equation of plane that pass through the following points

A=(1,0,0)  
B=(0,1,0)  
C=(0,0,-2)

$\vec{n} = \overrightarrow{AB} \times \overrightarrow{AC} = ([\text{input}], [\text{input}], [\text{input}])$

Equation of plain (for example  $x+y-z=0$ )  
[input] = 0  
(symbolic formula)

Submit the answer

Figure: Database of grades

# Online Homework - Numerical Analysis

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```
public static double SimpsonsRule(
    FunctionFDelegate f, double a, double b, int n)
{
    if (n % 2 != 0){
        throw new ArgumentException("n must be even"); }
        double h = (b - a) / n;
        double sum = f(a) + f(b);
        for (int i = 1; i < n; i += 2){
            double x = a + i * h;
            sum += 4 * f(x);}
        for (int i = 2; i < n - 1; i += 2){
            double x = a + i * h;
            sum += 2 * f(x);}
        return h / 3 * sum;
    }
```

# Online Homework - HTML Code

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```
<%@ Page Language="C#" AutoEventWireup="true" CodeFile  
  
<!DOCTYPE html>  
  
<html xmlns="http://www.w3.org/1999/xhtml">  
<head runat="server">  
    <title>Homework</title>  
    <script src="https://polyfill.io/v3/polyfill.min.js  
    <script id="MathJax-script" async  
        src="https://cdn.jsdelivr.net/npm/mathjax@3  
    </script>  
</head>  
<body>
```

# Online Homework - C# Code

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```
using System;
using System.Collections.Generic;
using System.Xml;
using System.Web;
using System.Web.UI;
using System.Web.UI.WebControls;

public partial class Homework_1 : System.Web.UI.Page
{
    public string HomeworkIDString = "Homework06";
    public bool debugMode = false;

    protected void Page_Load(object sender, EventArgs
    {
```

# Online Homework - PHP

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```
<?php
session_start();
if (isset($_POST['username']) && isset($_POST['password'])) {
    $xml = simplexml_load_file('users.xml');
    $users = $xml->xpath("/users/user");
    foreach ($users as $user) {
        if ($user->username == $_POST['username'] &&
            $_SESSION['username'] = (string)$user->username) {
            header('Location: welcome.php');
            exit;
        }
    }
    $error = "Invalid username or password.";
}
?>
```



ISO/TC 98

## ISO/TC 98/SC 2

### Reliability of structures

#### About

Secretariat: **PKN**

Committee Manager: **Ms Katarzyna Maciejczyk**

---

Chairperson (until end 2025): Dr Jacek Szafran

---

ISO Technical Programme Manager [TPM]: **Dr Anna Caterina Rossi**

ISO Editorial Manager [EM]: **Ms Sanjali Jain**

---

Creation date: 1980

**Figure:** ISO standardization committee

# Elsevier XML DTDs and Transport Schemas

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```
<ENTITY % ESJA.xmlns      "https://www.elsevier.com/xml/ja/dtd" >

<!-- attribute type entities -->

<ENTITY % docsubtypes     "({abs|add|adv|ann|brv|cal|chp|cnf|con|cop|cor|cpg|dis|dup|edb|edi|err|exm|
                             fla|ind|lit|mis|nus|ocn|pgl|pnt|prp|prv|pub|ren|req|ret|rev|sco|ssu|mic|dat|lst|osp|rpl|vid})" >

<!-- attribute group entities -->

<ENTITY % top-level.att   CDATA          #FIXED NESJA.xmlns;
                             xmlns        CDATA          #FIXED 'S.S';
                             version       CDATA          #FIXED NESCE.xmlns;
                             xmlns:ce     CDATA          #FIXED NESJA.xmlns;
                             xmlns:sa     CDATA          #FIXED NESJB.xmlns;
                             xmlns:slink  CDATA          #FIXED XMLINK.xmlns;
                             xml:lang     Niso639;        'en'"

<!-- article -->

<ELEMENT article          ( item-info, ce:floats?, head, body?, tail? )>
<!ATTLIST article
    %top-level.att;
    %docsubtypes;      "fla"

<!-- simplified article, suitable for edi, con and other pits -->

<ELEMENT simple-article   ( item-info, ce:floats?, simple-head, body?, simple-tail? )>
<!ATTLIST simple-article
    %top-level.att;
    %docsubtypes;      #REQUIRED

<!-- book review -->

<ELEMENT book-review      ( item-info, ce:floats?, book-review-head, body?, simple-tail? )>
<!ATTLIST book-review
    %top-level.att;
    %docsubtypes      (brv|err)      "brv"

<!-- examination -->

<ELEMENT exam             ( item-info, ce:floats?, simple-head,
                             ( ce:exam-answers | ce:exam-questions )+ )>
<!ATTLIST exam
    %top-level.att;
    %docsubtypes      (exm|err)      "exm"
```

Figure: XML format of the data

# Scopus atabase

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The screenshot shows the Scopus database search interface. At the top, there are tabs for 'Search', 'Alerts', and 'My list'. Below the tabs, a banner message states: 'Scopus released a new metric and improved interoperability with SciVal. [Read the blog](#).' The main search area is titled 'Document search' and includes links for 'Author search', 'Affiliation search', 'Advanced search', 'Browse sources', and 'Compare journals'. The search input field contains the text 'heart attack'. To the right of the input field is a dropdown menu set to 'Article Title, Abstract, Keywords' and a search button. Below the search input, there is a section for 'Limit to:' which includes options for 'Date Range (inclusive)' (Published, Added to Scopus in the last 7 days) and 'Document Type' (ALL). There are also checkboxes for 'Subject Areas' (Life Sciences, Health Sciences, Physical Sciences, Social Sciences & Humanities). At the bottom, there is a 'Search history' section showing two previous searches: '2 TITLE-ABS-KEY ( heart attack )' with 25,350 document results, and '1 TITLE-ABS-KEY ( engineering )' with 1,532,542 document results. The interface is annotated with numbered circles 1 through 12.

1 Search  
2 Alerts  
3 My list  
4 Scopus released a new metric and improved interoperability with SciVal. [Read the blog](#).  
5 Document search | Author search | Affiliation search | Advanced search | Browse sources | Compare journals  
6 heart attack | Article Title, Abstract, Keywords  
7 AND | Search for... | Article Title, Abstract, Keywords  
8 Add search field | Reset form  
9 Limit to:  
10 Date Range (inclusive)  
11 Published | All years | to | Present |  
12 Added to Scopus in the last | 7 | days  
13 Document Type  
14 ALL  
15 Subject Areas  
16 Life Sciences (> 4,300 titles)  
17 Health Sciences (> 6,800 titles; 100% Medline coverage)  
18 Physical Sciences (> 7,200 titles)  
19 Social Sciences & Humanities (> 5,300 titles)  
20 Search history  
21 2 TITLE-ABS-KEY ( heart attack )  
22 25,350 document results  
23 1 TITLE-ABS-KEY ( engineering )  
24 1,532,542 document results

Figure: Search in Scopus database

# Scopus Database

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The screenshot displays the Scopus search results page for the query "heart attack". The interface includes a top navigation bar with tabs for "Search", "Alerts", "My list", and "My Scopus". Below the search bar, the results are summarized as "25,959 document results". The left sidebar offers refinement options for "Year" (2015 to 2011) and "Author Name" (Diner, n.C. to Hentley, G.J.). The main results table lists various studies, with a context menu open over the first result, showing options like "View references", "Add to My List", "Create bibliography", "Email", and "Print".

Refine	Year	Author Name	Subject Area
Limit to	Exclude		
	2015 (1)	Diner, n.C. (85)	Medicine (27,500)
	2014 (1,151)	Rothwell, P.M. (80)	Biotechnology (2,192)
	2013 (1,552)	Davis, S.R. (62)	
	2012 (1,417)	Kouchalek, P.J. (61)	
	2011 (1,387)	Hentley, G.J. (58)	

Document	Author	Year	Journal	Cited by
1 The pathogenesis of atherosclerosis: A perspective for the 1990s	Ross, R.	1993	Nature	8124
2 Randomized trial of estrogen plus progestin for secondary prevention of coronary heart disease in postmenopausal women	Huller, S., G. Riggs, B. V.	1998	Journal of the American Medical Association	4773
3 Effect of intensive blood-glucose control with metformin on complications in overweight patients with type 2 diabetes (UKPDS 34)	Turner, R.	1998	Lancet	4589
4 Collaborative meta-analysis of randomised trials of antiplatelet therapy for prevention of death, myocardial infarction, and stroke in high risk patients	Balgent, C., Sudnow, C., Collins, R., Peto, R.	2002	British Medical Journal	4391
5 Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: The antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT)	Furberg, C.D., Wright Jr., J.T., Davis, B.R., L., Crow, R., Polonski, J.	2002	Journal of the American Medical Association	3577
6 2007 Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the World Health Organization	Mancia, G., De Backer, G., et al.	2007	Journal of Hypertension	3498

Figure: Sample search results

# List of Academic Databases

Name	Discipline(s)	Size (full-texts)	Description	Access cost	Open data	Provider(s)
Internet Archive Scholar	Multidisciplinary	25,000,000	Focus on fulltext search of <a href="#">open access</a> journals and conference proceedings	Free	Yes	Internet Archive
CORE <sup>[3]</sup>	Multidisciplinary	9,800,000 <sup>[4]</sup> (207,000,000 metadata <sup>[5]</sup> )	A full text aggregator of all open access papers from repositories (institutional, subject, <a href="#">preprints</a> , etc.) and journals. Around 20 million monthly active users.	Free	No <sup>[4]</sup>	Open University
CiteSeerX <sup>[6]</sup>	Multidisciplinary	8,401,126	Replaced CiteSeer, and ChemXSeer. Mainly <a href="#">Computer science</a> , <a href="#">Statistics</a> , <a href="#">Mathematics</a> .	Free	Semi-free <sup>[7]</sup>	Pennsylvania State University
Semantic Scholar	Multidisciplinary	8,100,000 <sup>[8]</sup> (200,000,000 metadata <sup>[9]</sup> )	Mostly computer science and biomedical publications. Powered by <a href="#">semantic analysis</a> .	Free	Semi-free <sup>[8]</sup>	Allen Institute for Artificial Intelligence
Europe PMC <sup>[10]</sup>	Biomedical	7,500,000 (39,000,000 metadata)	Abstracts & full text ( 7.5 million) biomedical and <a href="#">life sciences</a> articles (Dec 2020). Includes <a href="#">text mining</a> tools and links to external molecular and medical data sets.	Free	Yes	EMBL-EBI
PubMed Central (PMC) <sup>[11]</sup>	Biomedical, life sciences	7,500,000	Free full-text archive of publications and preprints	Free	Yes	NIH, NLM
ResearchGate	Multidisciplinary	4,000,000 <sup>[citation needed]</sup>	Commercial <a href="#">social networking</a> site for scientists and researchers. Over 19 million registered users that share their articles, datasets and other research output.	Free	No	ResearchGate GmbH
SSRN: Social Science Research Network	Social science	950,733	Research papers from more than 55 disciplines	Free & Subscription	No	Elsevier

Figure: Full-text databases

# SQL Queries

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- `SELECT Article.[AuthorListID] FROM Article WHERE (Article.[AuthorListID]='Article1');`
- `SELECT AuthorList.[AuthorListID] FROM AuthorList WHERE (AuthorList.[FirstName]='Pownuk');`

AuthorList					
	ID	FirstName	LastName	AuthorListID	Click to Add
	1	Pownuk	Andrzej	Book1	
	2	Skrzypczyk	Jerzy	Book1	
	3	Pownuk	Andrzej	Article1	
	5	Pownuk	Andrzej	Article2	
	6	Rama	Rao	Article2	
*	(New)				

Figure: Table of data

# Bibtex

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```
@article{nash51,  
  author   = "Nash, John",  
  title    = "Non-cooperative Games",  
  journal  = "Annals of Mathematics",  
  year     = 1951,  
  volume   = "54",  
  number   = "2",  
  pages    = "286--295"  
}
```

# Bibtex

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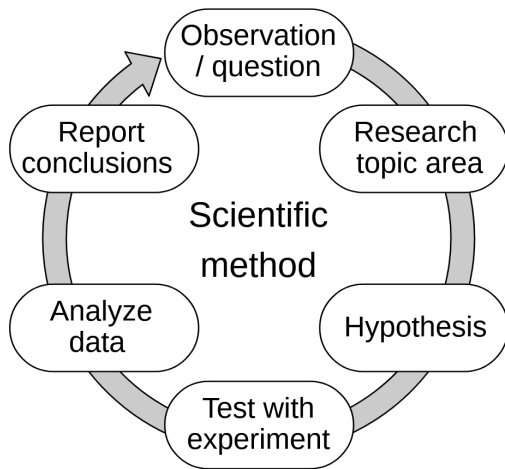
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- article: any article published in a periodical like a journal article or magazine article
- book: a book
- booklet: like a book but without a designated publisher
- conference: a conference paper
- inbook: a section or chapter in a book
- incollection: an article in a collection
- inproceedings: a conference paper (same as the conference entry type)
- manual: a technical manual
- masterthesis: a Masters thesis
- misc: used if nothing else fits



# Scientific Method (Aristotle 384–322 BCE)



# Set Theory

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## Theorem

$$(B \cap \bar{A}) \cup (A \cap B) = B$$

Automated theorem proving.

- $(B \cap \bar{A}) \cup (A \cap B) = (A \cap B) \cup (B \cap \bar{A}) =$   
 $((A \cap B) \cup B) \cap ((A \cap B) \cup \bar{A}) =$
- $= ((A \cup B) \cap (B \cap B)) \cap ((A \cup \bar{A}) \cap (B \cup \bar{A})) =$
- $= ((A \cup B) \cap B) \cap (U \cap (B \cup \bar{A})) =$   
 $((A \cup B) \cap B) \cap (B \cup \bar{A}) =$
- $= (A \cup B) \cap B \cap (B \cup \bar{A}) = (B \cup A) \cap (B \cup \bar{A}) \cap B =$   
 $(B \cup (A \cap \bar{A})) \cap B =$
- $= (B \cup \emptyset) \cap B = B \cap B = B$

## Theorem

$$(x, y \in \mathbb{N}_{\text{odd}}) \Rightarrow (x \cdot y \in \mathbb{N}_{\text{odd}})$$

Automated theorem proving.

- $x \in \mathbb{N}_{\text{odd}} \Rightarrow x = 2p + 1, p \in \mathbb{N}$
- $y \in \mathbb{N}_{\text{odd}} \Rightarrow y = 2q + 1, q \in \mathbb{N}$
- $x \cdot y = (2p + 1) \cdot (2q + 1) = 4pq + 2p + 2q + 1 = 2(2pq + p + q) + 1 = 2r + 1$
- $(p \in \mathbb{N}) \wedge (q \in \mathbb{N}) \Rightarrow (2pq + p + q = r \in \mathbb{N})$
- $(x \cdot y = 2r + 1) \wedge (r \in \mathbb{N}) \Rightarrow x \cdot y \in \mathbb{N}_{\text{odd}}$
- $\square$

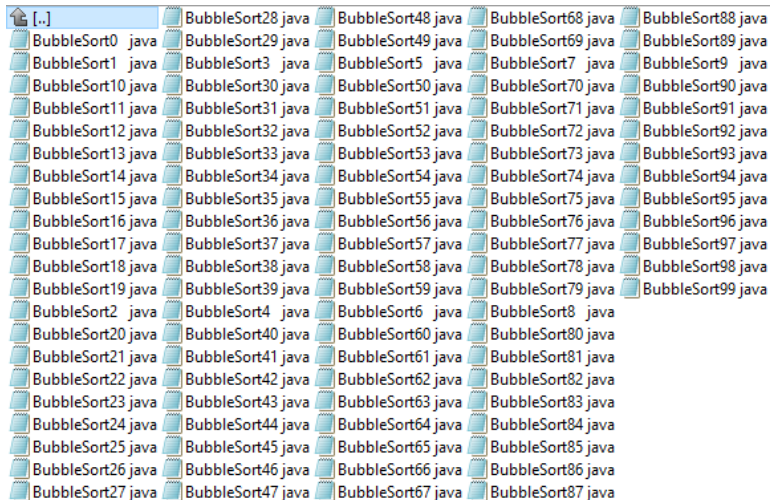
# Autonomous Code Generation

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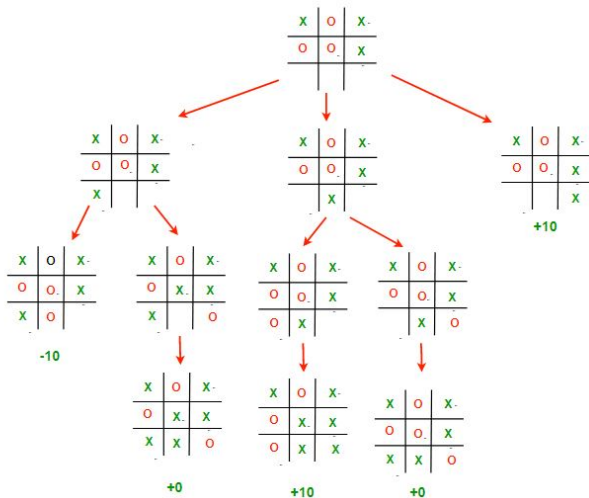
# Autonomous Code Generation - Monte Carlo Tree Search

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# Predictions Based on Machine Learning

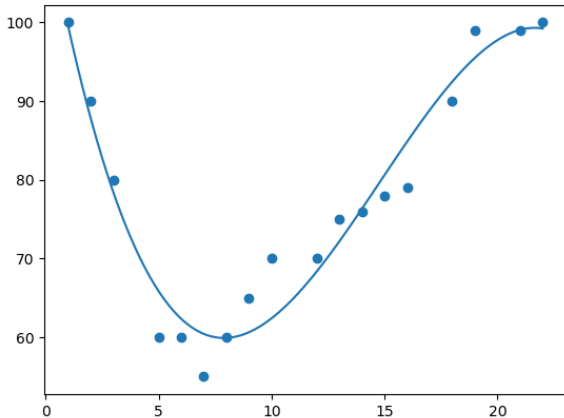
## Universal Approximation Theorem

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# Predictions Based on Large Language Models

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Learning

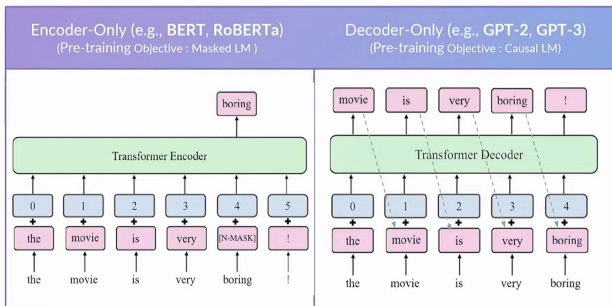
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Formally, language modeling is a test of assigning probabilities to sequences of words/sentences.

$$P(S_i) = P(x_1, \dots, x_j, \dots, x_n)$$



# Language Models

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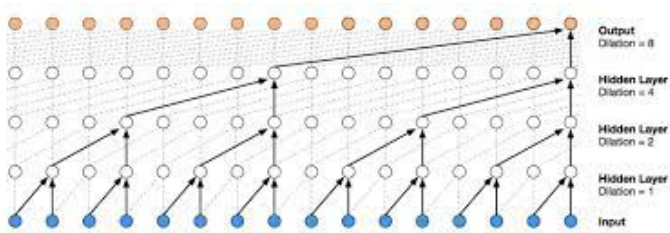


Figure: Autoregressive models



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Figure: Sample code for binary tree in Java (sample data structure)

# Sample Engineering Problem

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can you show detailed calculations?

Sure! Here are the detailed calculations for the bending moment in a simply supported beam with a point load at midspan:

The bending moment diagram is a parabola with its maximum value at midspan. The maximum bending moment is equal to  $\frac{1}{4} * P * L$  where P is the point load and L is the length of the beam.

For example, if the length of the beam is 10 meters and the point load is 1000 newtons, then the maximum bending moment would be:

$$\frac{1}{4} * 1000 \text{ N} * 10 \text{ m} = 2500 \text{ Nm}$$

I hope that helps. Let me know if you have any other questions.

Figure: Bending moment in the beam

# Sample Problem in Statistics

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derive the formula for the students test in statistics

✓ Searching for: formula for student's t-test

✓ Generating answers for you...

The formula for Student's t-test is used to determine whether two sets of data are significantly different from each other. The formula for the two-sample t-test (a.k.a. the Student's t-test) is shown below<sup>[1]</sup>:

$$t = (x_1 - x_2) / s(\sqrt{1/n_1 + 1/n_2})$$

where  $x_1$  and  $x_2$  are the sample means,  $n_1$  and  $n_2$  are the sample sizes for sample 1 and sample 2, respectively, and  $s$  is calculated as:

$$s = \sqrt{[(n_1-1)s_1^2 + (n_2-1)s_2^2] / (n_1+n_2-2)}$$

where  $s_1^2$  and  $s_2^2$  are the sample variances<sup>[2]</sup>.

I hope that helps. Let me know if you have any other questions.

Figure: Student's t-test

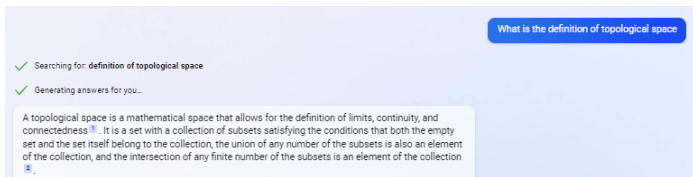
# Sample Problem in Mathematics

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The screenshot shows a search interface with a light blue background. In the top right corner, there is a dark blue button with the text "What is the definition of topological space". Below this, on the left, are two green checkmarks indicating search progress: "Searching for: definition of topological space" and "Generating answers for you...". A white rounded rectangle contains the definition of a topological space. At the bottom right of the interface, there are several small, faint icons for navigation and search.

What is the definition of topological space

✓ Searching for: definition of topological space

✓ Generating answers for you...

A topological space is a mathematical space that allows for the definition of limits, continuity, and connectedness [\[1\]](#). It is a set with a collection of subsets satisfying the conditions that both the empty set and the set itself belong to the collection, the union of any number of the subsets is also an element of the collection, and the intersection of any finite number of the subsets is an element of the collection [\[2\]](#).

Figure: Definition of the topological space

# Bibliography Management With The Language Model

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find a reference to the first paper about calculus by Leibnitz in bibtex format.

✓ Searching for: first paper calculus Leibnitz bibtex

✓ Searching for: first paper calculus Leibnitz bibtex

✓ Generating answers for you...

The first paper on calculus by Leibniz was published in 1684 in the October issue of Acta Eruditorum<sup>1</sup>. The name of the paper is known as "A New Method for Maxima and Minima, as Well Tangents, Which is not Obstructed by Fractional or Irrational Quantities"<sup>2</sup>.

Here's the BibTeX format for the paper:

```
@article{leibniz1684new,  
  title={A New Method for Maxima and Minima, as Well Tangents, Which is not Obstructed by  
Fractional or Irrational Quantities},  
  author={Leibniz, Gottfried Wilhelm},  
  journal={Acta Eruditorum},  
  volume={X},  
  pages={467--473},  
  year={1684}  
}
```

Figure: Bibtex format of the information about an article)

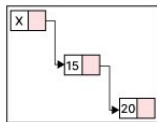
# Data Structures Optimization

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Learning

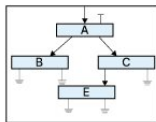
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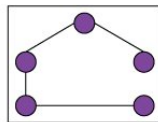
Conclusions



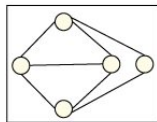
Link list



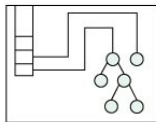
List



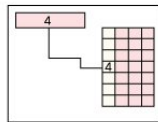
Spanning tree



Graph



Stack



Hashing

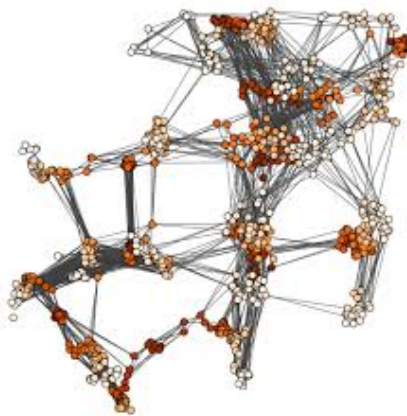
# Data Structures Optimization

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**Figure:** Dynamic optimization of data structures with scientific data

# Sample Results

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Conclusions

- Automatically generated online assignments.
- Self-improving optimized data which can be used to store scientific data.
- New algorithms which can be used in science in engineering.



# Conclusions

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Conclusions

- Online assignments are widely used in education.
- Online assignments are computer programs.
- By using Turing completed programming languages it is possible to describe wide range of scientific problems as online assignments.
- Storing scientific data in proper format improve quality of online assignments.
- It is possible to fully automate some aspects of the data structure optimization.

# Thank You