

1974 ACM Turing Award Lecture

[The Turing Award citation read by Bernard A. Galler, chairman of the 1974 Turing Award Committee, on the presentation of this lecture on November 11 at the ACM Annual Conference in San Diego.]

Citation: quote

cite (sth): to speak or write the exact words from a book / quote

e.g. He cited a passage from the professor's speech.

cite sth as sth: to mention (ذکر کردن) sth as a reason or example to support what you are saying.

e.g. He cited his heavy workload (حجم کار) as the reason for his breakdown.

read by: passive

chairman: boss (رئیس)

The A.M. Turing Award of the ACM is presented annually by the ACM to an individual selected for his contributions of a technical nature made to the computing community. In particular, these contributions should have had significant influence on a major segment of the computer field.

annually: سالانه

should have had: اثرش تا الان وجود داره

"The 1974 A.M. Turing Award is presented to Professor Donald E. Knuth of Stanford University for a number of major contributions to the analysis of algorithms and the design of programming languages, and in particular for his most significant contributions to the 'art of computer programming' through his series of well-known books. The collections of techniques, algorithms and relevant theory in these books have served as a focal point for developing curricula and as an organizing influence on computer science."

A.M. Turing: Alan Mathison Turing

present: ارائه دادن

represent: بازنمایی کردن

a number of + فعل / اسم جمع

number of + فعل / اسم مفرد

make contribution to

'art of computer programming': اسم کتاب

through: به واسطه، از طریق

focal point: central and important point

focus (کانون) → focuses / foci (جمع)

curriculum: جمع: currricula: - برنامه تحصیلی، دوره تحصیلی (مفرد)

e.g. Mathematics is on (Br.) / in (Am.) the curriculum.

Such a formal statement cannot put into proper perspective the role which Don Knuth has been playing in computer science, and in the computer industry as a whole. It has been my experience with respect to the first recipient of the Turing Award, Professor Alan J. Perlis, that at every meeting in which he participates he manages to provide the insight into the problems being discussed that becomes the focal point of discussion for the rest of the meeting. In a very similar way, the vocabulary, the examples, the algorithms, and the insight that Don Knuth has provided in his excellent collection of books and papers have begun to find their way into a great many discussions in almost every area of the field. This does not happen easily. As every author knows, even a single volume requires a great deal of careful organization and hard work. All the more must we appreciate the clear view and the patience and energy which Knuth must have had to plan seven volumes and to set about implementing his plan so carefully and thoroughly.

formal: رسمی

affiliation: تعلق داشتن

There are a number of books. The number of books is 20.

put into perspective: to compare sth to other things, so that it can be judged fairly and accurately. (حق مطلب را به درستی)
(ادا کردن، قضاوت منصفانه)

Put into perspective \neq out of perspective

as a whole: به صورت کلی

insight: intuition (شهود)

intuitively: شهوداً

e.g. Your solution is intuitively correct.

insight (into): the ability to see the truth about situation (بصیرت)

respect: relating to two or more persons individually (مربوطه)

e.g. They are successful in their respective fields.

respectively: e.g. A lack of (فقدان، کمبود) IT and financial management expertise (تخصص) come in second and third places respectively.

find one's way into sth: to arrive at a particular place unintentionally (ناخواسته، غیر عمدی) and by chance (تصادفی).

e.g. I found my way into counseling (مشاوره) after grief (غمه) became too much to bear (تحمل کردن).

volume: جلد

a great deal of / a large amount of + اسم غیر قابل شمارش

all the more: even more than before (بیش از پیش)

e.g. Several publishers (انتشاراتی‌ها) rejected his book, but that just made him all the more determined (مصمم).

set about: شروع کردن

implemented his plan: جامه عمل پوشاندن به یک برنامه

through: از طریق، به واسطه

thorough: completely (کامل و جامع)

It is significant that this award and the others that he has been receiving are being given to him after three volumes of his work have been published. We are clearly ready to signal to everyone our appreciation of Don Knuth for his dedication and his contributions to our discipline. I am very pleased to have chaired the Committee that has chosen Don Knuth to receive the 1974 A.M. Turing Award of the ACM.

discipline: field of study

e.g. CS is my discipline.

interdisciplinary: میان رشته‌ای، بین رشته‌ای

e.g. An interdisciplinary research program.

disciplined: trained to obey (فرمان‌برداری کردن) rules and behave (رفتار کردن) in a controlled way.

e.g. A disciplined science.

The (برای تأکید 2) قبل از حروف صدادار (1: دو جا دی خوانده می‌شود)

When Communications of the ACM began publication in 1959, the members of ACM'S Editorial Board made the following remark as they described the purposes of ACM's periodicals [2]: "If computer programming is to become an important part of computer research and development, a transition of programming from an art to a disciplined science must be effected." Such a goal has been a continually recurring theme during the ensuing years; for example, we read in 1970 of the "first steps toward transforming the art of programming into a science" [26]. Meanwhile we have actually succeeded in making our discipline a science, and in a remarkably simple way: merely by deciding to call it "computer science."

Editorial Board: هیئت تحریریه

make remark: متذکر شدن، نظر دادن

purpose: هدف

periodical: ماهنامه، هفته‌نامه (تخصصی)

e.g. ACM periodicals

to effect sth: to make sth happen

goal: هدف

continuous: happen without interruption (مستمر)

continual: recurs frequently or regularly (متناوب)

e.g. The wolf's continual howling echoed through the forest.

e.g. Recovery after the accident will be a continuous process that may take several months.

linear recurrence with constant (ثابت) coefficients (ضریب): رابطه بازگشتی خطی با ضرایب ثابت

ensuing: following

to ensure: to follow

toward (Am.) towards (Br.)

remarkably: چیزی که به طور خاصی ساده بود

Implicit in these remarks is the notion that there is something undesirable about an area of human activity that is classified as an "art"; it has to be a Science before it has any real stature. On the other hand, I have been working for more than 12 years on a series of books called "The Art of Computer Programming." People frequently ask me why I picked such a title; and in fact some people apparently don't believe that I really did so, since I've seen at least one bibliographic reference to some books called "The Act of Computer Programming."

implicit: ضمنی

notion: concept (مفهوم)

undesirable: ناخواسته، ناخوشایند

classified: رده بندی کردن

classification: رده بندی، دسته بندی، طبقه بندی

Typical classification levels: 1) unclassified < 2) confidential (محرمانه) < 3) secret < 4) top secret

confide in sb: to tell sb secrets because you feel you can trust himself

e.g. It is important to have someone you can confide in.

stature: 1) a person's natural height (قد و قامت) 2) importance of reputation (شهرت، اهمیت)

On the one hand, ..., on the other hand ...

apparently: ظاهراً

since: because

bibliographic: لیست کتاب ها

In this talk I shall try to explain why I think "Art" is the appropriate word. I will discuss what it means for something to be an art, in contrast to being a science; I will try to examine whether arts are good things or bad things; and I will try to show that a proper view-point of the subject will help us all to improve the quality of what we are now doing.

appropriate: مناسب

in contrast to: درمقابل

examine: به دقت بررسی کردن

weather: آب و هوا

whether: آیا یا نه

view-point: point of view (نقطه نظر، دیدگاه)

help [+to]

One of the first times I was **ever** asked about the title of my books was in 1966, during the last previous ACM national meeting **held** in Southern California. This was before any of the books were published, and I **recall** **having** lunch with a friend at the **convention** hotel. He knew how **conceited** I was, already at that time, so he asked if I was going to call my books "An Introduction to Don Knuth." I replied that, **on the contrary**, I was naming the books **after** him. His name: Art Evans. (The Art of Computer Programming, **in person**.)

ever: برای تأکید

hold: برگزار کردن

held: برگزار شد

recall: remember

convention: هتلی که برای منظور خاصی گرفته شده است (تجاری یا ...)

conceit: غرور بسیار

conceited: بسیار مغرور

replied: پاسخ دادن

on the contrary: برعکس

after: about (درباره)

e.g. She asked after you.

in person: face-to-face (حضور)

personally: شخصاً

e.g. He meets him in person.

e.g. He meets him personally

From this story we can conclude that the word "art" has more than one meaning. In fact, one of the **nicest** things about the word is that it is used in many different senses, each of which is **quite** appropriate in connection with computer programming. While preparing this talk, I went to the library to **find out** what people have written about the word "art" through the years; and after spending several **fascinating** days **in the stacks**, I **came to the conclusion** that "art" must be one of the **most interesting** words in the English language.

find out: فهمیدن

fascinating: جذاب

in the stacks: جاهایی از کتابخانه که هر کسی را راه نمی دهند و کتاب هایی که کمتر مراجعه می شوند آنجا نگهداری می شوند

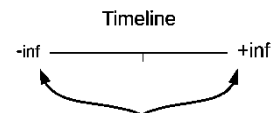
came to the conclusion: نتیجه گرفتن

“If debugging is the process off removing software bugs, then programming must be the process of putting them in.”

-Edsger Dijkstra

extreme: 1) (Adj.) very great in degree (e.g. extreme pressure)

2) (Adj.) as far as possible from the center (e.g. He sat on the extreme edge of his seat.)



The Arts of Old

If we go back to Latin roots, we find ars, artis meaning "skill." It is perhaps significant that the corresponding Greek word was $\tau\epsilon\chi\eta$, the root of both "technology" and "technique."

Nowadays when someone speaks of "art" you probably think first of "fine arts" such as painting and sculpture, but before the twentieth century the word was generally used in quite a different sense. Since this older meaning of "art" still survives in many idioms, especially when we are contrasting art with science, I would like to spend the next few minutes talking about art in its classical sense.

In medieval times, the first universities were established to teach the seven so-called "liberal arts," namely grammar, rhetoric, logic, arithmetic, geometry, music, and astronomy. Note that this is quite different from the curriculum of today's liberal arts colleges, and that at least three of the original seven liberal arts are important components of computer science. At that time, an "art" meant something devised by man's intellect, as opposed to activities derived from nature or instinct; "liberal" arts were liberated or free, in contrast to manual arts such as plowing (cf. [6]). During the middle-ages the word "art" by itself usually meant logic [4], which usually meant the study of syllogisms.

so-called: به اصطلاح

liberal arts: هنرهای مقدماتی، آزاد

namely: که عبارت اند از

e.g. I study two subjects namely physics and math.

rhetoric: the art of persuasion قانع کردن

e.g. It's empty rhetoric.

rhetorical (Adj.)

arithmetic: جبر، حسابان

as opposed to: برخلاف

devise: ابداع کردن

plow: plough (شخم زدن)

sylogisms: قیاس منطقی (روش به دست آوردن درستی یک گزاره از گزاره‌های فرضی درست)

Science vs. Art

The word "science" seems to have been used for many years in about the same sense as "art"; for example, people spoke also of the seven liberal sciences, which were the same as the seven liberal arts [1]. Duns. Scotus in the thirteenth century called logic "the Science of Sciences, and the Art of Arts" (cf. [12, p. 34f]). As civilization and learning developed, the words took on more and more independent meanings, "science" being used to stand for knowledge, and "art" for the application of knowledge. Thus, the science of astronomy was the basis for the art of navigation. The situation was almost exactly like the way in which we now distinguish between science" and "engineering."

stand for: 1) to be an abbreviation (خلاصه) or symbol of sth.

2) to support sth.

give advice to sb

a.g. Ask your teacher for advice on how to prepare for exam.

e.g. Let me gave you a piece of advice.

e.g. Take my advice, Don't do it!

e.g. I choose it on her advice.

Several sciences are often necessary to form the groundwork of a single art. Such is the complication of human affairs, that to enable one thing to be done, it is often requisite to know the nature and properties of many things ... Art in general consists of the truths of Science, arranged in the most convenient order for practice, instead of the order which is the most convenient for thought. Science groups and arranges its truths so as to enable us to take in at one view as much as possible of the general order of the universe. Art... brings together from parts of the field of science most remote from one another, the truths relating to the production of the different and heterogeneous conditions necessary to each effect which the exigencies of practical life require.

Affairs: امور

e.g. International affairs امور بین‌الملل

e.g. Foreign affairs امور خارجه

e.g. Business affairs امور تجاری

e.g. The debate (بحث) was a pretty disappointing (ناامیدکننده) affairs.

complication: پیچیدگی

requisite: required نیاز

e.g. He lacks the requisite experience for the job.

prerequisite (for / to / of): پیش نیاز

e.g. Good self-esteem (عزت نفس) is a prerequisite for a happy life.

e.g. A strong foundation in Math as a common prerequisite for studying.

convenient: ساده، راحت

heterogeneous: ناهمگن

cause and effect: علت و معلول

exigencies: an urgent (فوری) need ضرورت، نیاز مبرم

e.g. Exigencies of practical life.

As I was **Looking up** these things about the meanings of "art," I found that authors have been **calling for** a transition from art to science {or at least two centuries. For example, the **preface to** a textbook on **mineralogy**, written in 1784, said the following [171: "Previous to the year 1780, mineralogy, though **tolerably** understood by many as an Art, could **scarce** be **deemed** a Science."

Look up: جستجو کردن (در دیکشنری)

call for: To publically ask for sth happen.

e.g. call for paper (CFP)

e.g. The Data Science track (n.) calls for paper for the next international conference.

e.g. Calling for submission (ارسال) of abstracts (چکیده‌ها).

Camera-ready paper

preface: پیشگفتار

mineralogy: کانی شناسی، سنگ شناسی، مطالعه خواص معدنی، شیمیایی و فیزیکی مواد معدنی

tolerably: fairly well but not very well.

deem sth: consider sth

e.g. I deemed it an honor to be invited.

e.g. He deemed it prudent (عاقلانه) not to say anything.

scarce: 1) (Adv.) almost not e.g. I can scarce remember him.

2) (Adj.)

According to most dictionaries "science" means knowledge that has been logically arranged and **systematized** in the form of general "laws." The advantage of science is that it saves us from the need to think things through in each individual case; we can **turn our thoughts to** higher-level concepts. As John Ruskin wrote in 1853 [32]: "The work of science is to **substitute** facts for appearances, and **demonstrations** for impressions."

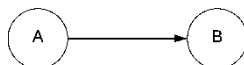
according to: طبق

systematized: to organize (سازماندهی کردن)

advantage: مزیت

turn one's thoughts to: to direct one's attention to (افکار را معطوف به چیزی کردن)

substitutes A for B (replace B with A)



substitutes A with / by B (replace with B)



demonstration: اثبات

adopt: 1) to adopt a child پذیرش شخص به فرزندی

2) e.g. Adopting a certain idea. اختیار کردن یک طریق یا روش

come sth to me (come an idea to me) ایده‌ای به ذهنم رسید

gut: (n.) دل و روده - (Adj.) based on feelings rather than reason.

e.g. You have to work on **gut instinct**!

Get more prestige

In the long run: در طولانی مدت

In the short run: در کوتاه مدت

e.g. We don't know what will happen in the long run.

herd: گله

Reader's Digest: A concise (خلاصه) or compressed version of sth.

e.g. I have to see sth **to the point** where I have surrounded it.

All of a sudden (Adv.): ناگهان

e.g. All of a sudden I had firm pegs (رخت‌آویز، گیره) on which I could hang other knowledge.

Flimsy: badly made, not strong enough

e.g. A flimsy table.

Somehow (Adv.): in a way that is not known. (به طریق)

e.g. I must get a new job somehow.

Somewhat: to some degree (تا اندازه‌ای)

e.g. Our work has progressed somewhat.

vague: مبهم

It seems to me that if the authors I studied were writing today, they would agree with the following characterization: Science is knowledge which we understand so well that we can teach it to a computer; and if we don't fully understand something, it is an art to deal with it. Since the notion of an algorithm or a computer program provides us with an extremely useful test for the depth of our knowledge about any given subject, the process of going from an art to a science means that we learn how to automate something.

consensus: متفق‌القول

characterization: توصیف صفات اختصاصی (سرشت‌نمایی)

e.g. The city is characterized by its tall buildings.

notion: concept, belief, idea

notation: a system of signs and symbols

e.g. Scientific notations.

Artificial intelligence has been making significant progress, yet there is a huge gap between what computers can do in the foreseeable future and what ordinary people can do. The mysterious insights that people have when speaking, listening, creating, and even when they are programming, are still beyond the reach of science; nearly everything we do is still an art.

make progress: پیشرفت کردن

e.g. We are not finished yet, but we are making progress.

yet: 1) (conjunction (حرف ربط)): nevertheless (با این وجود)

e.g. It is a small car, yet it is surprisingly specious (جادار).

2) (Adv.) (هنوز (در جملات منفی))

e.g. -Are you ready? +Not yet.

foreseeable: قابل پیش‌بینی

e.g. The foreseeable future.

From this **standpoint** it is certainly **desirable** to make computer programming a science, and we have **indeed** come a long way in the 15 years since the publication of the remarks I quoted at the beginning of this talk. Fifteen years ago computer programming was so badly understood that **hardly** anyone even thought about proving programs correct; we just **fiddled with a program** until we "knew" it worked. At that time we didn't even know how to express the concept that a program was correct, in any rigorous way. It is only in recent years that we have been learning about the processes of abstraction by which programs are written and understood; and this new knowledge about programming is currently producing great **payoffs** in practice, even though few programs are actually proved correct with complete rigor, since we are beginning to understand the principles of program structure. The point is that when we write programs today, we know that we could in principle construct formal proofs of their correctness if we really wanted to, now that we understand how such proofs are formulated. This scientific basis is resulting in programs that are significantly more reliable than those we wrote in **former days** when intuition was the only basis of correctness.

Computers are incredibly fast, accurate, and stupid.

Human beings are incredibly slow, inaccurate, and brilliant.

Together, they are powerful beyond imagination.

-Albert Einstein, Physicist

standpoint: viewpoint (نقطه نظر)

e.g. From an economic standpoint, the policy (خط مشق) **meets** the constraints.

fiddle with sth: to keep touching and moving sth with your hands because you are bored or anxious.

e.g. He was fiddling with his keys while he was talking to me.

e.g. He was nervously fiddling with his pen as he waited for the test to begin.

rigorous: extremely thorough (کامل) exhaustive and accurate.

rigor: سخت گیری و دقت زیاد

payoff: a final outcome (نتیجه نهایی، بازده)

e.g. You have to work hard, but there will be a big payoff.

former: (Adj.) (n.): پیشین، اولی ≠ latter: دومی، بعدی

e.g. Both the current and the former employees.

e.g. We were offered tea and coffee. I chose the former and he the latter.

e.g. I have two meetings today. The former is with my boss. The latter is with a client.

hardly (Adv.): به ندرت

validation: building the **right** things.

verification: building the things **right**. (V and V)

The field of "automatic programming" is one of the major areas of artificial intelligence research today. Its **proponents** would love to be able to give a lecture entitled "Computer Programming as an **Artifact**" (meaning that programming has become merely a **relic** of **bygone** days), because their aim is to create machines that write programs better than we can, given only the problem specification. Personally I don't think such a goal will ever be completely **attained**, but I **do** think that their research is extremely important, because everything we learn about programming helps us to improve our own **artistry**, in this sense we should **continually** be **striving** to transform every art into a science: in the process, we advance the art.

proponent (of sth): حامی یک عقیده یا عمل ≠ opponent (مخالف، رقیب)

e.g. The theory has still its proponents.

e.g. opponent of the plan.

e.g. He knocked out his opponent in the third round.

Artifact: محصول ساخت بشر

e.g. silver and gold artifacts.

relic (of sth / from sth): an object, tradition (سنت) that survived from the past.

bygone (Adj.): belonging to an earlier time. (That has gone by, past)

e.g. Videotapes may already seem like relics of a bygone era (عصر، دوره، زمان).

go by: سپری شدن زمان

e.g. Things will get easier as times goes by.

attain: به دست آوردن، نائل شدن، کسب موفقیت

e.g. attain a degree

artistry: هندمندی

continually: مداوم، متناوباً

strive: to try hard to achieve sth.

e.g. Striving **for** the highest standards. (for + noun)

e.g. Striving **against** laziness.

e.g. Striving **to** find a solution. (to + verb)

(Strive, Strove, Striven)

Science and Art

Our discussion indicates that computer programming is **by now** both a science and an art, and that the two **aspects** nicely complement each other. Apparently most authors **who** examine such a question **come to** this same **conclusion**, that their subject is both a science and an art, **whatever** their subject is (cf. [25]). I found a book about elementary photography, written in 1893, which stated that "the development of the photographic image is both an art and a

science" [13]. in fact, when I first picked up a dictionary **in order to** study the words "art" and "science," I **happened to glance at** the editor's preface, which began by saying, "The making of a dictionary is both a science and an art." The editor of Funk & Wagnall's dictionary [27] observed that the **painstaking accumulation** and **classification** of data about words has a scientific character, **while** a well-chosen phrasing of definitions demands the ability to write with **economy** and precision: "The science without the art is **likely** to be **ineffective**; the art without tile science is certain to be **inaccurate**."

by now: تا الان

aspect: جنبه

e.g. Aspect-Oriented programming

e.g. Aspect of Security

e.g. Aspect of Performance

weaving: بافتن

To happen: to do or be sth by chance (اتفاقی)

e.g. The door happened to be unlocked.

e.g. I happened to glance at ... = I glanced at ... by chance.

Come to the conclusion

In conclusion: finally

Lead (منجر شدن به) to the conclusion

economy: efficient and conservation (محافظة کارانه) use

e.g. Writing with an economy of language.

painstaking: done with great care. (چیزی که با دقت و وسواس زیاد انجام بشه) = meticulous (با دقت، با وسواس، با دقت فراوان به جزییات)

e.g. Painstaking attention to detail. (دقت فراوان به جزییات)

e.g. Do your task meticulously.

In order to: to

Accumulation: جمع آوری

Likely: probably, possibly

When preparing this talk I looked through the card catalog at Stanford library to see how other people have been using tile words "art" and "science" in the titles of their books. This turned out to be quite interesting.

For example, I found two books **entitled** The Art of Playing the Piano [5, 15], and others called The Science of Pianoforte 7"echtlique [10], The Science of Pianoforte Practice [30]. There is also a book called The Art of Piano Playing: A Scientific Approach [22].

Entitle: 1) مجوز چیزی را به کسی دادن

e.g. This ticket doesn't entitle you to travel first class.

2) دادن عنوان به چیزی

e.g. He read a poem entitled "Sorrow".

Then I found a nice little book entitled 7"he Gentle Art of Mathematics [31], which made me **somewhat** sad that I can't honestly describe computer programming as a "gentle art."

Somewhat Somehow

e.g. I did my project somewhat somehow.

describe sth as sth

gentle: ملایم

I had known for several years about a book called The Art of Computation, published in San Francisco, 1879, by a man named C. Frusher Howard [14]. This was a book on practical business arithmetic that had sold over 400,000 **copies** in various editions by 1890. I was amused to read the preface, since it shows that Howard's philosophy and the **intent** of his title were quite different from **mine**; he wrote: "A knowledge of the Science of Number is of minor importance; skill in the Art of **Reckoning** is absolutely **indispensable**."

intent: نیت، قصد

intentional: عمدی

It is of minor importance.

indispensable: absolutely necessary (لاینفک)

e.g. This is an indispensable reference book.

reckon: to think about sth

e.g. I reckon that I'm going to get the job.

e.g. It will be famous one day, what do you reckon?

Several books **mention** both science and art in their titles, **notably** 7"he Science of Being and Art of Living by Maharishi Mahesh Yogi [24]. There is also a book called The Art of Scientific Discovery [11], which analyzes how some of the great discoveries of science were made.

mention: ذکر کردن، گفتن

aforementioned: فوق‌الذکر

e.g. The aforementioned method uses a combinatorial approach.

Make discoveries

notably: بالاخص، به‌ویژه، قابل توجه

So much for the word "art" in its classical meaning. Actually, when I chose the title of my books, I wasn't thinking primarily of art in this sense, I was thinking more of its current **connotations**. Probably the most interesting book which **turned up** in my search was a **fairly** recent work by Robert E. Mueller called The Science of Art [29]. **Of all the books I've mentioned**, Mueller's comes closest to expressing what I want to make the central theme of my talk today, **in terms of** real artistry as we now understand the term. He observes: "It was **once** thought that the imaginative outlook of the artist was death for the scientist. And the logic of science seemed **to spell doom** to all possible artistic **flights of fancy**." He **goes on** to explore the advantages which actually do result from a **synthesis** of science and art.

connotations: (دلالت ضمنی) An idea suggested by a word in addition to its meaning.

e.g. The word 'professional' has connotations of skill and experience.

connote (V.): دلالت ضمنی کردن بر

e.g. For him the word family connotes comfort.

turn up: 1) بالا بردن (صدا و سطح و ...)

2) to arrive

3) to be found esp. by chance after being lost.

e.g. (1) Turn the TV up.

e.g. (2) We arranged to meet at 7. But he never turned up.

e.g. (3) Don't worry, I'm sure the letter will turn up.

turn down: 1) کم کردن (صدا، سطح و ...)

2) reject sth offered (رد کردن درخواست)

e.g. (2) His novel was turned down by publisher after publisher.

once: 1) یکبار

2) یک زمانی در گذشته

e.g. (1) He cleans his car once a week.

e.g. (2) The book was famous once, but nobody reads it today.

all the once: 1) suddenly

2) simultaneously (همزمان)

e.g. (2) I can't do everything all at once.

idiom: 1) once bitten, twice shy. (مارگزیده از ریسمان سیاه و سفید می ترسه.)

2) An unpleasant (ناخوشایند) experience induces caution (احتیاط).

induces: 1) include sb to do sth: persuade (مجبور کردن) sb to do sth

2) باعث شدن، منجر شدن به

e.g. (1) Nothing would induce me to take job.

e.g. (2) None of these measures (تمهیدات) induces a change in my policy.

Countermeasure

to spell doom: to spell trouble, disaster, ... (منجر به حادثه بد شدن)

e.g. To meet your doom ((سرنوشت بد)).

rational (adj.): reasonable \neq irrational

e.g. A rational analysis.

rationale (N.): reason

e.g. What is the rationale behind this?

flight of fancy (خیال): An idea that shows a lot of imagination but is not practical.

e.g. The book is filled with flights of fancy about the future of the computer industry.

synthesis: ترکیب (سنتز)

in terms of: برحسب

e.g. In function $y = 12 - 7x$, y is expressed in terms of x . (برحسب)

go on: keep on, carry on (ادامه دادن)

A scientific approach is generally characterized by the words logical, systematic, impersonal, calm, rational, while an artistic approach is characterized by the words aesthetic, creative, humanitarian, anxious, irrational. It seems to me that both of these apparently contradictory approaches have great value with respect to computer programming.

Characterized: سرشت‌نمایی

impersonal: سرد و بی‌عاطفه

aesthetics: علم زیبایی‌شناسی

aesthetic: مربوط به علم زیبایی

e.g. The building has little aesthetic value.

humanitarian: philanthropic (بشردوستانه)

e.g. humanitarian help

anxious: مضطرب

anxiety: اضطراب

contradiction: تناقض

proof by contradiction: برهان خلف

contradictory: conflicting (متناقض)

with respect to: نسبت به

e.g. The derivation of function $f(x)$ with respect to x .

e.g. The two groups were similar with respect to income and status.

Emma Lehmer wrote in 1956 that she had found coding to be "an **exacting** science **as well as** an **intriguing** art" [23]. H.S.M. Coxeter remarked in 1957 that he sometimes felt "more like an artist than a scientist" [7]. This was at the time C.P. Snow was beginning to **voice** his alarm at the growing polarization between "two cultures" of educated people [34, 35]. He pointed out that we need to **combine scientific and artistic** values if we are to make real progress.

exacting: 1) making severe (سخت و شدید) demands (مته به خشخاش گذاشتن، مو را از ماست بیرون کشیدن)

2) requiring care and effort

e.g. (1) An exacting instructor.

e.g. (2) An exacting task.

as well as: همچنین

e.g. I study as well as go.

e.g. I study and work as well (too).

severe: سخت و شدید

severity

intriguing: very interesting because of being unusual.

e.g. These discoveries raise intriguing questions.

intrigue sb: to make very interested and want to know more about sth.

e.g. You have really intrigued me. Tell me more!

raise: باعث شدن (حالت متعدی)

rise: حالت لازم

voice sth: ابراز کردن

e.g. A number of parents have voiced concern about their children's safety.

Diphthong: دو حرف صدادار در یک سیلاب ممکن است بر هم (تلفظ کلمه) تأثیرگذار باشد.

Works of Art

When I'm sitting in an audience listening to a long lecture, my attention usually starts to **wane** at about this point in the hour. So I wonder, are you getting a little tired of my **harangue** about "science" and "art"? I really hope that you'll be able to listen carefully to the rest of this, anyway, because now comes the part about which I fled most deeply.

Wane: to become weaker gradually decrease, fade (افول)

e.g. His popularity was waning somewhat.

e.g. Full moon → waning moon

Idiom:

wax and wane (بالا و پایین شدن در گذر زمان)

e.g. Public interest in the issue has waxed and waned over the years.

harangue: نطق آتشین

When I speak about computer programming as an art, I am **thinking** primarily **of** it as an art form, in an aesthetic sense. The **chief goal** of my work as educator and author is to help people learn how to write beautiful programs. It is for this reason I was especially pleased **to learn** recently [32] that my books actually appear in the Fine Arts Library at Cornell University. (However, the three volumes apparently sit there neatly on the shelf, without being used, so I'm afraid the librarians may have made a mistake by interpreting my title **literally**.)

chief goal: ultimate goal (هدف غایی)

literal (In computer): int a = 1; 1 is an integer literal / string s = "Cat" cat is a string literal

literal (Adj.): 1) تحت الفظی

2) to emphasize a phrase even if it is not true.

e.g. (1) Dreadful in its literal meaning: full of dread.

e.g. (2) I literally jumped out of my skin (متعجب شدم).

literally (Adv.):

e.g. The word planet literally means "wandering body".

e.g. Idioms usually can not be translated literally to another languages.

A is B ().

A is B. ()

My feeling is that when we prepare a program, it can be like **composing** poetry or music; as Andrei Ershov has said [9], programming can give us both intellectual and emotional satisfaction, because it is a real achievement to master complexity and to establish a system of consistent rules.

e.g. compose a poem (سرودن شعر)

Furthermore when we read other people's programs, we can **recognize** some of them as **genuine** works of art. I can still remember the great **thrill** it was for me to read the listing of Stan Poley's SOAP II assembly program in 1958; you probably think I'm crazy, and styles have certainly changed greatly since then, but at the time it meant a great deal to me to see how elegant a system program could be, especially by comparison with the **heavy-handed** coding found in other listings I had been studying at the same time. The possibility of writing beautiful programs, even in assembly language, **is** what got me **hooked on** programming **in the first place**.

recognize sth **as** sth

genuine: اصلی و باصالت

thrill: هیجان

heavy-handed: using unnecessary force (یک نیروی الکی را صرف کردن)

in the first place: at the beginning of a series of events. (ابتدا به ساکن، در وهله اول)

e.g. We should never have agreed to let him borrow the money in the first planet.

Be hooked on sth: enjoying sth very much so that you want to do it more & more.

e.g. I was first hooked on scuba diving when I was twelve.

Some programs are **elegant**, some are **exquisite**, some are **sparkling**. My **claim** is that it is possible to write grand programs, treble programs, truly **magnificent** ones!

elegant (Adj.): attractive and stylish

e.g. an elegant man

e.g. an elegant room

exquisite: extremely beautiful and carefully made.

sparkling: 1) flashing with lights

2) fizzy

3) interesting and amusing

e.g. (1) sparkling eyes

e.g. (2) sparkling mineral water

claim (N.) , (V.): 1) ادعا کردن، ادعا

2) formally request or demand something

e.g., (1) I don't claim to be an expert.

e.g., (2) If no one claims the items they will become crown property.

disclaim: deny

e.g. They disclaimed any responsibility for the problem.

disclaimer: A statement that denies something, especially responsibility (رفع کننده مسئولیت)

reclaim: get back, claim back (پس گرفتن)

e.g. An operating system manages process termination by reclaiming its resources.

acclaim: praise مورد تشویق / ستایش قرار دادن

e.g. The book has been widely acclaimed as a modern novel.

exclaim: cry out suddenly in surprise, strong emotion, or pain (با شور و حرارت فریاد زدن)

e.g. After the match, the fans exclaimed that it was the best match they had ever seen.

exclamation mark: !

proclaim: announce officially or publicly (اعلان عمومی کردن)

e.g. The doctors proclaimed a state of emergency.

magnificent: very impressive and attractive.

e.g. The Taj Mahal is a magnificent building.

etymology: ریشه شناسی

Taste and Style

The idea of "style in programming is now coming to the forefront" at last, and I hope that most of you have seen the excellent little book on Elements of Programming Style by Kernighan and Plauger [16]. in this connection it is most important for us all to remember that there is no one "best" style; everybody has his own preferences, and it is a mistake to try to force people into an unnatural mold. We often hear the saying, "I don't know anything about art, but I know what I like." The important thing is that you really like the style you are using; it should be the best way you prefer to express yourself.

coming to the forefront

e.g. When the pandemic hit, remote work practices come to the forefront.

forefront: The most noticeable and important position.

noble: very impressive in quality.

mold: قالب ریخته گری

C programming language (Kernighan & Ritchie)

Edsger Dijkstra stressed this point in the preface to his Short Introduction to the Art and Programming [8]:

It is my purpose to transmit the importance of good taste and style in programming, [but] the specific elements of style presented serve only to illustrate what benefits can be derived from "style" in general. In this respect I feel akin to the teacher of" composition at a conservatory: He does not teach his pupils how to compose a particular symphony, he must help his pupils to find their own style and must explain to them what is implied by this. (It has been this analogy that made me talk about "The Art of Programming.")

akin to sth: similar to sth

conservatory: 1) هنرستان هنرهای زیبا

2) green house (گلخانه)

e.g. (2) The greenhouse effect

pupil: 1) شاگرد مدرسه

2) مردمک چشم

analogy: همانندی، شباهت

e.g. He drew an analogy between the brain and a cpu.

analogously: به طور قیاسی

e.g. We analyzed the most interesting cases, those we omit (حذف کردن) can be treated analogously.

Now we must ask ourselves, What is good style, and what is bad style? We should not be too rigid about this in judging other people's work. The early nineteenth-century philosopher Jeremy Bentham put it this way [3, Bk. 3, Ch. 1]:

Judges of elegance and taste consider themselves as benefactors to the human race, whilst they are really only the interrupters of their pleasure. There is no taste which deserves the epithet good, unless it be the taste for such employments which, to the pleasure actually produced by them, conjoin some contingent or future utility: there is no taste which deserves to be characterized as bad, unless it be a taste for some occupation which has a mischievous tendency.

judge: قضاوت

Benefactor: خیر

benefactors: خیرین

e.g. The benefactors of the hospital.

epithet: لقب، صفت

e.g. The film is long and dramatic but doesn't quite earn the epithet 'epic' (حماسی).

conjoin: to join together

e.g. conjoin twins.

contingent (N.): a group of people at a meeting who have sth in common, esp, the place they come from.

e.g. The largest contingent was from the Japan.

contingent on / upon sth (Adj.): مشروط به

e.g. Plans contingent on the weather.

mischievous: بدجنس

It is important **for** him **to** attend everyday. (important for sb / sth to v.)

It is important **to** me that you should be there. (important to sb + sentence)

When we apply our own **prejudices** to "reform" someone else's taste, we may be **unconsciously** denying him some entirely **legitimate** pleasure. That's why I don't **condemn** a lot of things programmers do, even though I would never **enjoy** doing them myself. The important thing is that they are creating something they feel is beautiful.

prejudices: تعصب

unconsciously: ناخودآگاه

legitimate: قانونی

condemn: محکوم کردن

In the passage I just quoted, Bentham does give us some advice about certain principles of aesthetics which are better than others, namely the "utility" of the result. We have some freedom in setting up our personal standards of beauty, but it is especially nice when the things we regard as beautiful are also regarded by other people as useful. I must **confess** that I really enjoy writing computer programs; and I especially enjoy writing programs which do the greatest good, in some sense.

confess: اعتراف کردن

There are many senses in which a program can be "good," of course. In the first place, it's especially good to have a program that works correctly. Secondly it is often good to have a program that won't be hard to change, when the time for adaptation **arises**. Both of these goals are achieved when the program is easily readable and understandable to a person who knows the appropriate language.

arise: occur (رخ دادن) (arise, arose, arisen)

Another important way for a production program to be good is for it to interact gracefully with its users, especially when recovering from human errors in the input data. It's a real art to compose meaningful error messages or to design flexible input formats which are not **error-prone**.

prone: liable (مستعد چیز بد)

e.g. prone to injury

e.g. error-prone

e.g. injury-prone

Another important aspect of program quality is the efficiency with which the computer's resources are actually being used. I am sorry to say that many people nowadays are condemning program efficiency, telling us that it **is in bad taste**. The reason for this is that we are now experiencing a reaction from the time when efficiency was the only reputable **criterion** of goodness, and programmers in the past have tended to be so **preoccupied with** efficiency that they have produced **needlessly** complicated code; the result of this unnecessary complexity has been that **net efficiency** has gone down, due to difficulties of debugging and maintenance.

exploit: make full use of and derive benefit from (بهره‌برداری کردن حداکثری)

Be in bad, (poor) ... taste: حال به هم زن

Be in good ... taste: حال به هم نزن

criterion: معیار

criteria: معیارها

preoccupied with: مشغول بودن شدید ذهن

needless: غیر ضروری

net efficiency: کارایی خالص، کارایی کل

net (nett): خالص مانده

net income: after the tax has been paid

gross: مانده ناخالص

Gross income

reputable: خوشنام ≠ disreputable

The real problem is that programmers have spent far too much time worrying about efficiency in the wrong places and at the wrong times; **premature optimization is the root of all evil** (or at least most of it) in programming.

Premature optimization is the root of the evils.

We shouldn't be **penny wise** and **pound foolish**, **nor should we** always think of efficiency in terms of so many percent gained or lost in total running time or space. When we buy a car, many of us are almost **oblivious** to a difference of \$50 or \$100 in its price, while we might make a special **trip to** a particular store in order to buy a 50¢ item for only 25¢. My point is that there is a time and place for efficiency; I have discussed its proper role in my paper on structured programming, which **appears** in the current issue of Computing Surveys [21].

penny wise: wise only in dealing with small matters ≠ pound foolish

Oblivious (to / of): بی‌اعتنا، فراموشکار

e.g., He drove off, oblivious of the damage he had caused.

trip = voyage (space ship) = journey: سفر کوتاه

Less Facilities: Mere Enjoyment

One rather, **curious** thing I've noticed about aesthetic satisfaction is that our pleasure is significantly enhanced when we, **accomplish** something with limited tools. For example, the program of which I personally am most pleased and proud is a compiler I once wrote for a primitive minicomputer which had only 4096 words of memory, 16 bits per word. It makes a person feel like a real **virtuoso** to achieve something **under** such severe restrictions.

curious (Adj.): 1) کنجکاو

2) strange, unusual

curiosity (n.)

virtuoso (n.): A person who is extremely skillful at doing sth esp. playing a musical instruments.

e.g., A piano virtuoso.

Under such severe restrictions.

Under this circumstance condition.

Curriculum Vitae (CV): Latin for 'Course of one's life'

Summa Cum Lande: A degree that was earned with the highest distinction.

e.g., He graduated **summa cum lande (adv.)** with a degree in physics.

proficiency: a high degree of skill

A similar **phenomenon** occurs in many other contexts. For example, people often seem to fall in love with their Volkswagens but rarely with their Lincoln Continentals (which **presumably** run much better). When I learned programming, it was a popular **pastime** to do as much as possible with programs that fit on only a single punched card. I suppose it's this same phenomenon that makes APL **enthusiasts** **relish** their "one-liners." When we teach programming nowadays, it is a curious fact that we rarely capture the heart of a student for computer science until he has taken a course which allows **"hands on"** experience with a minicomputer. The use of our large-scale machines with their fancy operating systems and languages doesn't really seem to **engender** any love for programming, at least not at first.

phenomenon: رخداد طبیعی

(Pl.) phenomena

presumably: probably

e.g., They can presumably afford (از پس خرید برآمدن) to buy a new car.

pastime: hobby

enthusiasm: اشتیاق

enthusiastic (adj.) مشتاق

enthusiast (n.) شخص مشتاق

relish: to enjoy

hands-on (adj.): doing sth rather than just talking about it.

e.g., A hands-on computer programming.

engender: to make a feeling or situation exist.

e.g., The plane engender feelings of friendship.

e.g., The issue engender controversy (مشاجره، جروبحث)

controversial (adj.)

e.g., A highly controversial topic.

It's not obvious how to apply this principle to increase programmers' enjoyment of their work. Surely programmers would **groan** if their manager suddenly announced that the new machine will have only half as much memory as the old. And I don't think anybody, even the most dedicated "programming artists," can be expected to welcome such a **prospect**, since nobody likes to lose facilities unnecessarily. Another example may help to clarify the situation: Film-makers strongly resisted the introduction of talking pictures **in the 1920's** because they were justly proud of the way they could convey words without sound. Similarly, a true programming artist might well **resent** the introduction of more powerful equipment; today's **mass storage** devices tend to spoil much of the beauty of our old tape sorting methods. But today's film makers don't want to go back to silent films, not because they're lazy but because they know it is quite possible to make beautiful movies using the improved technology. The form of their art has changed, but there is still **plenty of room** for artistry.

groan: moan (شکایت و ناله کردن)

prospect: A possibility that sth will happen. (چشم‌انداز، دورنما)

e.g., There is no prospect of peace among the team members.

e.g., A place in semi-finals is in prospect (likely to happen (احتمالاً)).

In **the** 1920's

References Available upon requests

Einstein's Formula is $E = mc^2$ **where** E is the energy, m is the mass, and c is the speed of light.

convey: to make ideas, feelings known to sb.

e.g., Colors like red convey a sense of energy.

e.g., He tried to convey how urgent the situation was.

e.g., Please convey my apologize to him.

convoy: کاروان ماشین‌های نظامی یا کشتی‌های جنگی

A convoy of trucks

convoy effect (مفهوم در سیستم عامل)

resent: اظهار تنفر و خشم از چیزی

resentful of / about sth

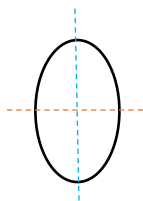
e.g., A resentful look.

plenty of room: فضای زیادی برای چیزی وجود داشتن (غیرقابل شماش)

wise (suffix): 1) in the manner or direction of (در جهت)

2) with regard to

e.g., (1) likewise, clockwise, anticlockwise, lengthwise [cut], crosswise [cut], stepwise (قدم به قدم)



lengthwise cut

crosswise cut

e.g., (1) A piece of paper folded lengthwise.

e.g., (2) pennywise, dollarwise, security wise

How did they develop their skill? The best film makers through the years usually seem to have learned their art in comparatively primitive **circumstances**, often in other countries with a limited movie industry. And in recent years the most important things we have been learning about programming seem to have originated with people who did not have access to very large computers. The **moral** of this story, it seems to me, is "that we should **make use of** the idea of" limited resources in our own education. We can all benefit by doing occasional "toy" programs, when artificial restrictions are set up, so that we are forced to **push our abilities to the limit**. We shouldn't live **in the lap of luxury** all the time, since that tends to make us **lethargic**. The art of **tackling** mini problems with all our energy will **sharpen our talents** for the real problems, and the experience will help us to get more pleasure from our accomplishments on less restricted equipment.

circumstances: condition (موقعیت)

circumference (محیط دایره)

circumvent = detour

circumflex

moral: پند اخلاقی

push one's abilities to the limit: to do sth to the very best of one's abilities (تا جایی که ممکن است تلاش کردن)

in the lap of luxury: در ناز و نعمت

e.g., We spent two weeks in the hotel in the lap of luxury.

lethargic: سست و بی حال

e.g., The weather made him lethargic.

lethargy: inertia (بی حالی)

e.g., Inertia is the resistance of a body (جرم) to being moved.

tackling sth: to deal with the difficult problem or situation. (مواجهه شدن با چیزی)

tackle: face with, deal with, cope with

e.g., We are failing to tackle the key issues.

Idiom:

Sour grapes: used to say that someone is pretending that he dislikes sth because he wants it but cannot have it.

e.g., Tom said his Rival's comment were just sour grapes.

Mathematicians stand on each other's shoulder.

-Carl Friedrich Guass

In a similar vein, we shouldn't shy away from "art for art's sake"; we shouldn't feel guilty about programs that are just for fun. I once got a great kick out of writing a one-statement ALGOL program that invoked an innerproduct procedure in such an unusual way that it calculated the rth prime number, instead of an innerproduct [19]. Some years ago the students at Stanford were excited about finding the shortest FORTRAN program which prints itself out, in the sense that the program's output is identical to its own source text. The same problem was considered for many other languages. I don't think it was a waste of time for them to work on this; nor would Jeremy Bentham, whom I quoted earlier, deny the utility of such pastimes [3, Bk. 3, Ch. 1]. "On the contrary," he wrote, "there is nothing, the utility of which is more incontestable. To what shall the character of utility be ascribed, if not to that which is a source of pleasure?"

vain: 1) useless (بیهوده)

2) conceited

e.g., (1) A vain attempt to hold tears.

in vain: unsuccessfully

e.g., All efforts were in vain.

vanity (n.)

Idiom:

To go up in smoke: to come to no practical results.

e.g., The dream is about to go up in smoke.

imminent: about to happen (قريب الوقوع)

e.g., The preemptive attack is imminent. (pre-emptive: پیش دستی)

vein: 1) سیاه‌رگ

2) a particular manner

e.g., (2) A number of other people commented in a similar vein.

Artry: سرخ‌رگ

shy away from sth: to avoid doing sth because you feel nervous or scared.

e.g., We frequently shy away from making decisions.

get a kick (هیجان) out of

e.g., I get a kick out of driving fast cars.

invoke: فراخوانی کردن

e.g., calling a function (invoke)

identical: یکسان

utility: usefulness, beneficial

incontestable: indisputable (غیر قابل انکار یا بحث)

e.g., an incontestable fact

ascribed sth to sb: منتسب کردن نوشته به کسی / منتسب کردن رخداد چیزی به دلیلی

e.g., He ascribed his failure to bad luck.

ascription (n.)

e.g., This play is usually ascribed to Shakespeare.

Providing Beautiful Tools Another characteristic of modern art is its emphasis on creativity. It seems that many artists these days couldn't care less about creating beautiful things; only the **novelty** of an idea is important. I'm not recommending that computer programming should be like modern art in this sense, but it does lead me to an observation that I think is important. Sometimes we are assigned to a programming task which is almost hopelessly **dull**, giving us no **outlet whatsoever** for any creativity; and at such times a person might well come to me and say, "So programming is beautiful? It's all very well for you to **declaim** that I should take pleasure in creating elegant and **charming** programs, but how am I supposed to make this **mess** into a work of art?"

novelty: جدید

dull: boring, uninteresting

outlet for sth: a way of expressing or making good use of strong feelings. (مفر، وسیله بیان)

e.g., He needs to find an outlet for his many talents.

e.g., Sport become the perfect outlet for his aggression.

whatsoever: به هیچ وجه، ابداً

e.g., My school did nothing whatsoever (بعد از فعل) in the way of athletics.

e.g., They received no help whatsoever. (آن‌ها ایداً هیچ کمکی دریافت نکردند.)

declaim (against sth): رجزخوانی کردن، با شور علیه کسی یا چیزی صحبت کردن

e.g., He declaimed against the evils of cigar.

e.g., She declaimed against the famous opening speech of the play.

charming: very attractive

mess: a dirty or untidy state. (بههم ریختگی)

e.g., The room was **in a mess**.

e.g., **What a mess!** He said, surveying the scene after the kids left.

Quote:

A computer is like air conditioning. It becomes useless when you open windows.

-Lius Torvalds

Idiom:

To save face: to take an action or make a gesture intended to preserve one's reputation or behavior. (حفظ ظاهر کردن)

e.g., I managed to save face by being able to speak about the topic, although the presentation that was made very bad.

Well, it's true, not all programming tasks are going to be fun. Consider the "trapped housewife," who has to **clean off** the same table every day: there's not room for creativity or artistry in every situation. But even in such cases, there is a way to make a :) improvement: it is still a pleasure to do routine jobs if we have beautiful things to work with. For example, a person will really enjoy wiping off the dining room table, day after day, if it is a beautifully designed table made from some fine quality **hardwood**.

clean off: to remove sth from sth by brushing, rubbing

hardwood

Idiom:

To spill the beans: to reveal secret information unintentionally.

e.g., You should never tell me a secret! I hope I don't spill the beans by mistake.

Therefore I want to **address** my closing remarks to the system programmers and the machine designers who produce the systems that the rest of us must work with. Please, give us tools that are a pleasure to use, especially for our routine assignments, instead of providing something we have to fight with. Please, give us tools that encourage us to write better programs by enhancing our pleasure when we do so.

address: 1) to make a formal speech to a group of people

2) to think about a problem and decide how are going to deal with it

e.g., (1) The dean has been asked to address the students.

e.g., (2) Your essay does not address the real issues.

It's very hard for me to convince college **freshmen** that programming is beautiful, when the first thing I have to tell them is how to punch "slash slash JOB equals **so-and-so**." Even job control languages can be designed so that they are a pleasure to use, instead of being strictly **functional**.

freshmen (frosh (informal)): -freshman year

-a freshman (student)

sophomore (soph); second year university / high school student

junior (jr)

senior (sr)

so-and-so: فلان و فلانی

e.g., The gossip about so-and-so.

e.g., All his fault, the the witched little so-and-so.

functional: practical and useful without decoration.

Quote:

90% of the functionality delivered now is better than 100% delivered never.

-Brian Kernighan

Idiom:

Pull the rug (carpet) (out) from under one's feet: to take help or support away from sb suddenly. (پشت کسی را خالی کردن)

e.g., I felt like someone had pulled the rug out from under my feet when my health insurance stopped paying for my medical bills.

Computer hardware designers can make their machines much more pleasant to use, {for example by providing floating-point arithmetic which satisfies simple mathematical laws. The facilities presently available on most machines make the job of rigorous error analysis hopelessly difficult, but properly designed operations would encourage numerical analysts to provide better subroutines which have certified accuracy (cf. [20, p. 204]).

Let's consider also what software designers can do. One of the best ways to **keep up** the spirits of a system user is to provide routines that he can interact with. We shouldn't make systems too automatic, so that the action always goes on **behind the scenes**; we **ought to** give the programmer-user a chance to direct his creativity into useful channels. One thing all programmers have in common is that they enjoy working with machines; so let's keep them in the loop. Some tasks are best done by machine, while others are best done by human insight; and a properly designed system will find the right balance. (I have been trying to avoid misdirected automation for many years, cf. [18].)

keep up: preserve (حفظ کردن، تداوم بخشیدن)

e.g., Keep up the good work.

Keep up with sb or sth: همگام و هم سرعت با چیزی در حال حرکت یا رشد

e.g., I can't keep up with all the changes.

e.g., Slow down! I can not keep up with you.

behind the scenes: پشت پرده

ought to = should

Program measurement tools make a good **case in point**. For years, programmers have been unaware of how the real costs of computing are distributed in their programs. Experience **indicates that** nearly everybody has the wrong idea about the real bottlenecks in his programs; it is no wonder that attempts at efficiency **go awry** so often, when a programmer is never given a breakdown of costs according to the lines of code he has written. His job is something like that of a newly married couple who try to plan a balanced budget without knowing how much the individual items like food, shelter, and clothing will cost. All that we have been giving programmers is an optimizing compiler, which mysteriously does something to the programs it translates but which never explains what it does. Fortunately we are now finally seeing the appearance of systems which give the user credit for some intelligence; they automatically provide **instrumentation of programs** and appropriate feedback about the real costs. These experimental systems have been a huge success, because they produce measurable improvements, and especially because they are fun to use, so I am confident that it is only a matter of time before the use of such systems is standard operating

procedure. My paper in Computing Surveys [21] discusses this further, and presents some ideas for other ways in which an appropriate interactive routine can **enhance** the satisfaction of user programmers.

case in point: example (مثال، نمونه)

e.g., What follows is a case in point. (آنچه در ادامه آمده است، مثالی است از ...)

indicates that: نشان می‌دهد که

go awry: if sth goes awry, it doesn't happen in the way that was planned. (از بین رفت، اونطوری که باید پیش رفت)

e.g., All my carefully laid plans went awry!

awry: untidy (نامرتب)

instrumentation of a program: دست بردن اتوماتیک داخل کد جهت اهداف و خواسته‌ها

enhance: پیشرفت دادن، بزرگ کردن

Language designers also have an obligation to provide languages that encourage good style, since we all know that style is strongly influenced by the language in which it is expressed. The present surge of interest in structured programming has revealed that none of our existing languages is really ideal for dealing with program and data structure, nor is it clear what an ideal language should be. Therefore I look forward to many careful experiments in language design during the next few years.

Idiom:

Put the cart (کالسکه) before the horse: to reverse the proper order

e.g., You are putting the cart before the horse by designing the website before defining the business goals.

Quote:

A mathematician is a machine for turning coffee into theorem.

-Pau Edros

Summary

To summarize: We have seen that computer programming is an art, because it applies accumulated knowledge to the world, because it requires skill and ingenuity, and especially because it produces objects of beauty. A programmer who subconsciously views himself as an artist will enjoy what he does and will do it better. Therefore we can be glad that people who lecture at computer conferences speak about the state of the Art.

درس‌های ۱ تا ۲۴ -- درس‌های ۳۸ تا ۴۰ -- درس‌های ۴۲ تا ۴۴ -- درس‌های ۹۲ تا ۹۶ -- درس ۱۰۴ -- درس‌های ۱۱۴ و ۱۱۵ - درس ۱۲۱

38, 39, 40, 114, 115

گاهی در شرطی نوع سوم، if حذف می‌گردد.

Had I known I was going to be late, I would have called you.

Had I only woken up five minutes earlier, I wouldn't have missed the bus.

You do sth now **in case** sth happens later.

یعنی یه کاری را الان انجام می‌دهی تا یه کاری که در آینده ممکن است اتفاق بیفتد را جبران کنیم.

Just in case: "برای محکم کاری" به اصطلاح به معنی

Unless = except if

Unless = if ... not

e.g. Unless you leave now, we will be late. = If you don't leave now, we will be late.

As long as / So long as

e.g. You can borrow my car as long as / so long as you promise not to drive too fast.

Borrow: قرض گرفتن

e.g. Member can only borrow books.

Lend: قرض دادن

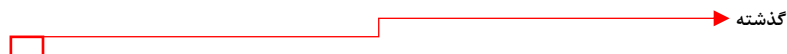
e.g. Can you lend me your car?

Provided (that)

وقتی این اتفاق می‌افتد که **quite** با صفات **non-gradable** بیاید.

Providing (that)

e.g. Traveling by car is convenient provided (that) / providing (that) you **have** (زمان حال) somewhere to park.



دروس ۴۲ و ۴۳ و ۴۴ گرامر (Passive voice)

(که از طریق فعل قابل بیان است. Subject و object اشاره به ارتباط بین) Passive voice

برای ساختن حالت مجهول یک جمله:

to be + past participle form of the verb شکل مناسبی از فعل

Tom built this house.

Passive: This house was built.

Tom cleans this room.

Passive: This room is cleaned.

Tom will clean this room.

Passive: This room will be cleaned.

Tom should have cleaned this room.

Passive: This room should have been cleaned.

Tom has cleaned this room. (ماضی نقلی / حال کامل – Present perfect tense)

Passive: This room has been cleaned.

Tom had cleaned this room.

Passive: This room had been cleaned.

Tom is cleaning this room.

Passive: This room is being cleaned.

Tom was cleaning this room.

Passive: This room was being cleaned.

درس ۴۴ گرامر

بعضی افعال دارای دو مفعول هستند.

Ask / offer / pay / show / tell

My Grandfather gave me this watch.

I was given this watch.

This watch is given to me.

There was a fight but nobody got (was) hurt.

I don't get invited. = I'm not invited.

He didn't offered the job. = He was not offered the job.

افعال زیر معنای غیر passive دارد:

Get lost

Get dressed

Get changed

دروس ۹۲ تا ۹۶ گرامر

Relative Clause

Everybody **who come to the meeting** enjoyed.

The man who (that) lives next door to me is a doctor.

People who (that) complain all the time are boring.

I don't like stories that (which) have unhappy endings.

The machine that (which) broke down is working again.

That / who (for human)

That / which (for things)

Who / that / which is the subject of the relative clause.

نمی توان کلمات **Which, that, who** را حذف کرد.

Where are the keys that (which) were on the table?

Who / that / which is the object of the relative clause

می توان حذف کرد.

Did you find the keys that (which) you lost?

نکته در مورد حذف حروف اضافه:

Tom is talking to a man. Do you know him?

Do you the man (that / who) Tom is talking to?

درس ۹۴ گرامر

Tom is talking to a man. Do you know him?

Do you know the man Ton is talking to?

We helped some people whose car had broken down.

I met someone whose (معمولاً برای اشخاص) brother I went to school with.

I met the author whose book I am reading.

Goerge is a person whom (formal / object) I admire very much.

It is important to have friends with whom (object) you can relax.

The restaurant where we had lunch was near the airport.

The reason (that / why / ...) I'm calling you.

درس ۹۵ گرامر

Do you know anyone **who / that** speaks English? (Relative clause انسان)

Grace works for a company **which \ that** makes furniture. (Relative clause شیء)

She stayed at the hotel (**that / which**) you recommended.

می توان حذف کرد. **Object** را توصیف می کند. (مفعول)

This morning I met somebody (**who / that**) I hadn't seen for years.

John **who speaks English** works as a tour leader.

Anna told me about her new job, **which she is enjoying a lot**.

She stayed at the park hotel, **which a friend of ours recommended**.

This morning I met Chris, **whom / who I hadn't seen for ages**.

1. a is positive.
2. Two is the only even prime.
3. If $x > 0$ $g(x) = 0$.
4. We minus the equation.
5. $x^2 + 1$ has no real solution.
6. When you times it by negative x, becomes _____.
7. The set of solutions are all odd.
8. $\sin(\pi x) = 0 \Rightarrow x$ is integer.
9. An invertible matrices is when the determinant is non-zero.
10. This infinate sequence has less negative terms.

e.g., \rightarrow Abbreviation for the Latin *exempli gratia*, meaning ‘for the sake of example’.

corresponding author: نویسنده در ارتباط با جمله

correspondingly

one-to-one correspondence: تناظر یک به یک

injective: یک به یک

surjective: پوشا

correspondent: متناظر

correspondence: مکاتبه

precede: A precede B. B is preceded by A. \rightarrow preceding

proceed: ادامه دادن

proceedings: کتابچه مقالات چاپ شده در کنفرانس

e.g., This paper is published in proceedings of the 22nd symposium on graph theory.

equilateral triangle: مثلث متساوی الاضلاع

isosceles triangle: مثلث متساوی الساقین

right-angled triangle: مثلث قائم الزاویه

right angle: زاویه قائم

hypotenuse: وتر

scalene triangle: مثلث مختلف الاضلاع

unilateral: یک جانبه

e.g., A unilateral decision.

multilateral: چند جانبه

e.g., A multilateral negotiation مذاکرات چند جانبه

$$fraction = \frac{numerator}{denominator}$$

principle: rule, law, guide line

principal: مدیر مدرسه

معمولاً اعداد بزرگ را به صورت عددی می نویسیم و اعداد کوچک را به صورت حروف می نویسیم.

وقتی منظور از عدد، عدد خاص باشد (جدا از کوچک یا بزرگ بودنش)، به صورت عددی نوشته می شود.

⇒ implication (استلزام) operator

Identity: اتحاد

Adjacency matrix: ماتریس مجاورت

00100011000

Leading zeroes

Trailing zeroes

coefficient: ضریب

monotony: یکنوایی

simplistic: making a problem seem less difficult than it is. (ساده انگارانه)

e.g., This interpretation of the theory was too simplistic.

emphatic: an emphatic statement, answer ... is given with force to show that is important.

e.g., An emphatic rejection.

Jargon: especial words and expressions used by a profession or group that are difficult for others to understand.

The equation $ax^2 + bx + c = 0$ is a fundamental equation in math__ it was discovered by.

So-called: به اصطلاح

Naïve: مبتدیانه

Curly brackets: {}

Customary: مرسوم

Multiset: if repeated elements are allowed in a set, then we speak of a multiset.

e.g., {2, 1, 3, 1, 3}

multiplicity: 1) the quality or state of being multiple or various

2) a great number

1 is the root of multiplicity 2. $((x - 1)^2)$

Definition $A := \{1, 2, 3\}$

$A := \{1, 2, 3\}$: Assignment Statement

A : definiendum (things to be defined)

$:=$: Assignment Operator. (It reads 'becomes' or is 'defined to be'.)

$\{1, 2, 3\}$: definiens (things that defines)

Assignment signs: $\begin{cases} := \\ \stackrel{\text{def}}{=} \\ \triangleq \end{cases}$

Trivial: بدیهی

Pair wise: دو به دو

Commute: travel some distance between one's home and place of work on a regular basis.

Ambient set: مجموعه دربرگیرنده تمام مجموعه‌ها

Commutative: جابجاپذیر ($A \times B = B \times A$)

Cartesian product: $A \times B$ (A and B are sets)

Ellipsis: '...' ($\mathbb{N} = \{1, 2, 3, \dots\}$) – plurals: ellipses

plurals: $\begin{cases} \text{Paranthesis} \rightarrow \text{Parantheses} \\ \text{Analysis} \rightarrow \text{Analyses} \\ \text{Thesis} \rightarrow \text{Theses} \end{cases}$

$E(x)$: x is even

$$A = \begin{cases} \{x \mid E(x)\} \\ \{x: E(x)\} \end{cases}$$

Reduced form: $\frac{a}{b} : \gcd(a, b) = 1$

Russell-Zermelo Paradox: $W = \{x : x \notin x\}$

$$W \in W \rightarrow W \notin W$$

$$W \notin W \rightarrow W \in W$$

برای حل تناقض فوق از تعریف زیر استفاده می‌کنیم:

تعریف هر مجموعه:

The set of numbers of X (ambient set) that have property P.

$$x = \left\{4, \left\{4, \left\{4, \{4\}\right\}\right\}\right\} \Rightarrow x \notin x \rightarrow x \in W$$

$$x = \left\{4, \left\{4, \left\{4, \{4, \dots\}\right\}\right\}\right\} \Rightarrow x \in x \rightarrow x \notin W$$

Continued fractions: $1 + \frac{1}{1 + \frac{1}{\dots}}$ کسره‌های مسلسل

$\forall x P(x), E(x): x \text{ is even} \rightarrow P(x) \text{ and } E(X) \text{ are predicates.}$

Predicate: مسند

(In math): a statement or mathematical assertion that contains variables.

valuation: 1) an estimation of the worth of something, especially one carried out by a professional valuer

2) the monetary worth of something

Arithmetic operations (ارزش‌گذاری)

Addition (+)	
$term + term$	$= sum$
$summand + summand$ (جمع‌وند)	
$addend + addend$	
$augend + addend$	

Subtraction (-)	
$term - term$	$= difference$
$minuend - subtrahend$	

Multiplication (×)	
$factor \times factor$	$= product$
$multiplier \times multiplicand$	

Division (\div)	
$\frac{\text{dividend}}{\text{divisor}}$	$= \begin{cases} \text{fraction} \\ \text{quotient} \\ \text{ratio} \\ \text{remainder} \end{cases}$
$\frac{\text{numerator}}{\text{denominator}}$	

Exponentiation ($^$)	
$\text{base}^{\text{exponent}} = \text{power}$	
$b^n \rightarrow$	$\begin{cases} b \text{ raised to the } n^{\text{th}} \text{ power} \\ b \text{ (raised) to the power of } n \\ \text{The } n^{\text{th}} \text{ power of } b \\ b \text{ to the } n^{\text{th}} \text{ power} \\ b \text{ to the } n^{\text{th}} \end{cases}$

$n^{\text{th}} \text{root} (\sqrt[n]{\square})$	
$\text{degree} \sqrt{\text{radicand}} = \text{root}$	

Logarithm ($\log \square$)	
$\log_{\text{base}}(\text{anti-logarithm}) = \text{logarithm}$	

IQ = Intelligence Quotient

EQ = Emotional Quotient

partition of 7: $\begin{cases} 4 + 3 \\ 1 + 1 + 5 \\ 2 + 2 + 3 \end{cases}$

composition of 7 (ترتیب اعداد مهم است): $\begin{cases} 4 + 3 \\ 3 + 4 \end{cases}$

vacuously true: $p \rightarrow q \equiv T \Rightarrow \text{چون} \Rightarrow p \equiv T$

reciprocal: وارون $\rightarrow \frac{1}{x}$

opposite: $-x$

raised ellipsis

ordinary ellipsis

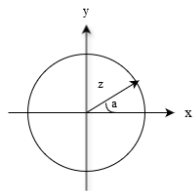
proper divisor: هر مقسوم‌الیه n که 1 یا n نباشد

GCD: greatest common divisor

LCM: least common multiple

Inter product: a, b : ضرب داخلی

Argand plane:



argand diagram of $x + iz$

degenerate: In math, a degenerate case is a limiting case of objects which appears to be different from (and simpler than) the rest of the class.

نقطه در مجموعه شامل همهٔ interval ها یک degenerate case است.

نقطه در مجموعه همهٔ دایره‌ها یک degenerate case است.

$$(a, b): \begin{cases} \text{بازهٔ باز بین } a \text{ و } b \\ \text{بزرگترین مقسوم‌علیه مشترک (GCD)} \\ \text{زوج مرتب} \end{cases}$$

Semi-demi-hemi

semi-circle / semi-sphere / semi-centennial

centennial (adv.): relating to a hundredth anniversary

centennial (n.): a hundredth anniversary

line: خط

segment: پاره خط

ray: نیم خط

$$(x, y) \in \mathbb{R}^2$$

x: abscissa (Plural: abscissae)

y: ordinate

ordinary ellipsis: x, \dots, x

raised ellipsis: $x \dots x$ or $x + \dots + x$

origin: مبدأ



infinitely many points (not infinite) → هر وقت می خواهیم صفت را توصیف کنیم، قید می آوریم.



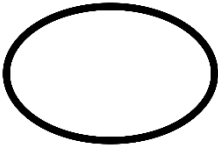
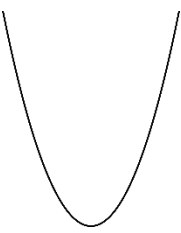
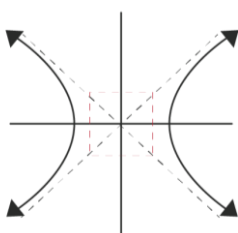
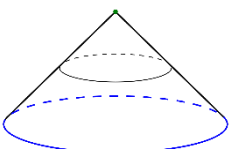
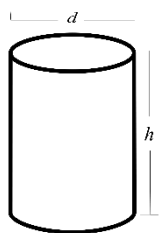
The tall red tree

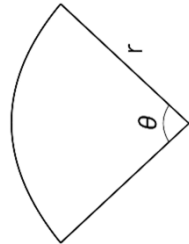

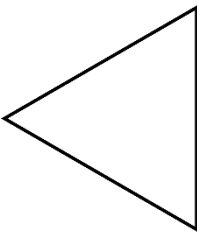




strongly connected component

represent: بازنمایی کردن

e.g., The figure 1 represent the set of Natural numbers.

ellipse	parabola	hyperbola	cone	cylinder
بیضی	سپهری	هذلولی	مخروط	استوانه
				

				
sector		triangle		segment

Identity (function) on A.

$$I_A: A \rightarrow A$$

conjunction identity: اتحاد مزدوج

Graph of $f: \{(x, f(x)) \in A \times B : x \in A\}$

هر تابع توسط ۳ مورد زیر به طور کامل مشخص می شود:

1) Domain

2) Co-domain

3) graph

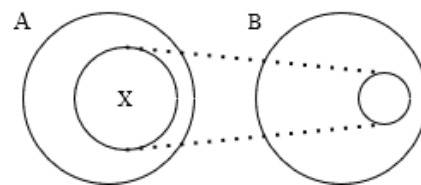
$y = f(x) \Rightarrow y$ is the value of function at x , denoted by $f(x)$.

$$f: A \rightarrow B$$

$$x \subset A$$

$$\Rightarrow f(X) \stackrel{\text{def}}{=} \{f(x) : x \in X\}$$

$f(X)$ is the image of X under f .



$f(A)$ is the smallest set that **surve** as co-domain.

$f(A)$ is called the **image** or the **range** of f .

constant: تابع ثابت

an injection function (one-to-one): تابع یک به یک

injection: یک به یک بودن

a surjective function (onto): تابع پوشا

surjection: پوشا بودن

a bijective function: تابع یک به یک و پوشا

one-to-one correspondence: تناظر یک به یک

function of f to X .

$$f|_X : X \rightarrow B$$

$$f: A \rightarrow B$$

$$g: B \rightarrow C$$

Composition of f and g : $g \circ f: A \rightarrow C$

$$(g \circ f)(x)$$

$$f: A \rightarrow B$$

$$f^{-1}: B \rightarrow A \text{ (inverse of } f\text{)}$$

$$f^{-1} \circ f = 1_A$$

هر عضو از A را به یک عضو از B می‌برد.

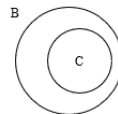
$$f \circ f^{-1} = 1_B$$

هر عضو از B را به یک عضو از A می‌برد.

تابع invertible است اگر یک به یک باشد.

$$f: A \rightarrow B$$

$$f^{-1}(C) \stackrel{\text{def}}{=} \{x \in A : f(x) \in C\} \text{ inverse image of the set } C.$$



The order of algorithm is denoted by O.

surmise: to conjecture (حدس زدن)

arbitrary: دلخواه

A function which coincides (رو هم افتادن، با هم رخ دادن) with its own inverse (تابعی که خودش یا معکوسش روی هم می‌افتند) is called **involution**.

Trigonometric function: تابع مثلثاتی

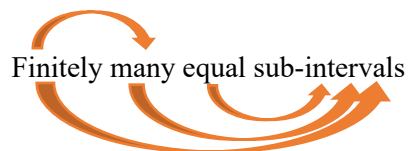
A family of sets

A set of sets

A collection of sets

At interval: بازه

At intervals



Finitely many equal sub-intervals

plane: صفحه

concentric: متحدالمرکز

annulus: حلقه‌ای شکل (plural: annul)

focus: کانون (plural: foci)

fungus: قارچ (plural: fungi)

alumnus (plural: alumni)

radius: شعاع (plural: radii)

cactus (plural: cacti)

nucleus: هسته (plural: nuclei)

diameter: قطر

stipulate: to state clearly and firmly (تصریح کردن)

modular arithmetic: حساب پیمانه‌ای، نظریهٔ هم‌نهشتی

$x \stackrel{m}{\equiv} y$: x and y are congruent modulo m . (هم نهشت هستند)

modulus: پیمانه

congruent: هم‌نهشت

congruent triangles: مثلث‌های هم‌نهشت

similar triangles: مثلث‌های متشابه

congruent class or residue (ته‌مانده) class: کلاس هم‌نهشتی

$$m = 4 \Rightarrow \begin{cases} [0]_4 = \{0, 4, 8, \dots\} \\ [1]_4 = \{1, 5, 9, \dots\} \\ [2]_4 = \{2, 6, 10, \dots\} \\ [3]_4 = \{3, 7, 11, \dots\} \end{cases}$$

tangent: 1) خط مماس

2) مماس

Point of tangency: نقطهٔ مماس

$A \sim B$: A is equivalent to B .

If and only if (iff)

There is a **bi-unique correspondence** between the elements of A and B .

bi-unique correspondence (one-to-one in both directions or هم یک به یک و هم پوشا)

(x, y)

Abscissa: x coordinate

Ordinate: y coordinate

$$y = ax + b$$

x-intercept: طول از مبدأ

y-intercept: عرض از مبدأ

slope: شیب خط

Interception: قطع کردن

Ingenuity: نبوغ

Ingenious: نابغه

Subconscious: ناخودآگاه

e.g., Many advertisements work at a subconscious level.

State-of-the-art: مدرن و پیشرفته و بهروز

e.g., A state-of-the-art system

surge: 1) to move quickly with force in a particular direction

2) to suddenly increase in value

e.g., (1) The gate opened and the crowd surged forward.

e.g., (2) The stock market (بازار سهام) surged to a record.

Look forward to: با اشتیاق در انتظار و چشم به راه بودن

e.g., We look forward to seeing you.

I try **to** (مصدری) go.

An approach **to** sorting ...

Accumulated: روی هم انباشته شده، جمع شده

The Greek alphabet:

Capital	Lowercase	Name
<i>A</i>	α	alpha
<i>B</i>	β	beta
<i>Γ</i>	γ	gamma
<i>Δ</i>	δ	delta
<i>E</i>	ε	epsilon
<i>Z</i>	ζ	zêta
<i>H</i>	η	êta
<i>Θ</i>	θ	thêta
<i>I</i>	ι	iota
<i>K</i>	κ	kappa
<i>Λ</i>	λ	lambda
<i>M</i>	μ	mu
<i>N</i>	ν	nu
<i>Ξ</i>	ξ	xi
<i>O</i>	o	omikron
<i>Π</i>	π	pi
<i>P</i>	ρ	rho
<i>Σ</i>	σ, ς	sigma
<i>T</i>	τ	tau
<i>Υ</i>	υ	upsilon
<i>Φ</i>	φ	phi
<i>X</i>	χ	chi
<i>Ψ</i>	ψ	psi

Ω	ω	omega
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