so the usually when you start talking

01:21

about something just you try to make a

01:23

you try to make a definition of it

01:26

and what is artificial intelligence um

01:29

unfortunately we don't have a perfect

01:31

answer for this one

01:34

for many fields of the science for many

01:36

fields of the engineering

01:38

you can define yourself with very

01:41

definitive sentences like we are this

01:43

and this and we are not that on that and

01:46

for the ai

01:48

we don't have very good

01:50

definition of it and this definition

01:52

changes

01:53

over the time

and in fact many people working in the

01:56

field of ai

01:58

they don't like the name of artificial

02:00

intelligence

02:02

okay

02:03

what is artificially about our

02:05

intelligence what is nature of the

02:07

intelligence and these kind of questions

02:09

are difficult questions to answer

uh mostly

02:13

nowadays people i mean if they say that

02:14

okay ai is this term is invented

02:18

in

02:19

in nineteen

02:22

1956 something like that okay very old

02:24

term

so nowadays if if if if they say that if

02:29

i am deciding the name today maybe it

02:31

would have been

02:32

computational intelligence instead of

02:35

artificial intelligence

02:37

because there is some intelligence and

02:38

there is some

02:42

computation going on let's call this

02:44

computational intelligence etc but the

02:46

name is there

02:47

and we are we are using it okay maybe

02:50

for turkish it could be “hesaplamalı akıl,hesaplamalı zeka”

02:54

yes

02:56

would there be a better term but anyway

how would you define it what are two

03:18

sentences

03:22

yes a machine that can learn how to

03:25

solve a problem

03:27

a machine that can learn how to solve

03:29

their problem yeah that's that's there's

03:32

a

03:32

nice definition of some part of

03:35

artificial intelligence maybe

03:37

i mean yeah learning is

03:40

learning is something that we like in an

03:43

artificial intelligence system but there

03:45

are

03:46

many

03:47

artificial intelligence systems that

03:49

don't know how to learn but still

03:52

they are they are they are behaving

03:54

With an intelligent

04:32

we can we can do it like this okay it

04:34

was it was idea in

04:36

1950s

04:39

this guy his name is turing elven Turing “Alan Turing”

04:42

okay

04:44

he's a british mathematician and

04:46

computer scientist okay

04:49

he died very

04:50

early young young age 1950 okay 54

04:55

he is the one that led

04:57

the team

04:58

uh that uh

05:00

saw this german secret code of

05:02

messaging the shifting the german eric

05:04

mccoy in world war ii so some people say

05:07

that

05:08

this guy is the one who won the world

05:10

for the british

05:12

uh

05:13

some people don't agree what

05:15

i mean his name is there so he is one of

05:18

the

05:19

the first

05:21

big names of computer science

05:23

and the first computer program belongs

05:25

to him

05:26

he says things like what is computable

05:29

and

05:30

not computable okay but given a problem

05:33

this is a computable problem or not

05:35

computable problem

05:37

he can he can

05:38

say that okay

05:40

he has those and he says that

05:42

i don't know what artificial

05:44

intelligence is but if if a

05:47

system say that it is smart

05:49

then

05:50

we can test that system like this

okay there is a person

06:14

or a computer

06:16

and it is the task of this person to

06:19

determine at the other side you have a

06:21

person or a computer okay

06:25

if i can if a computer can fool

06:28

this person for maybe 10 minutes

06:30

and this person cannot determine if it's

06:32

a computer or person

06:34

then we can say that

06:36

this system is an intelligent system

for example this one is asking a

06:41

question like

06:42

okay

06:43

who is the president of united states

06:46

and this one is asking giving me a uh

06:49

answer back this one says that it is

06:52

a joe biden okay that's a baby easy

06:54

question

06:55

how about how about this one

06:57

uh how about another question

07:00

how do you feel today so this one should

07:02

okay it is trying to disguise itself as

07:04

like a person right it says i am feeling

07:07

fine well you know

07:09

today it is uh uh

07:11

it is the wind is from the southern

07:13

event lodos and it is making is giving

07:15

me some headaches etc

07:17

so

07:18

it is trying to fool this person into

07:19

thinking that it's a computer

07:22

so he says that the training says that

07:24

if a computer system can pass this test

07:28

at least it can survive for 10 minutes

07:31

okay

07:32

we can call this system we can call this

07:35

system

07:37

uh

07:38

an intelligent system

he said that any artificially

08:53

intelligent system should behave like a

08:55

human

08:56

okay

08:58

so what is wrong with this approach you

09:00

just tell me

09:02

this approach is not accepted anymore

09:04

okay into it beginning in

09:06

1990s people said that well this is not

09:09

a good definition of artificial

09:11

intelligence

09:13

and why

09:19

nowadays there are systems that can

09:21

survive maybe 30 minutes

09:23

in 30 minutes you want

09:26

30 minutes you want uh you want you want

09:28

you won't know that the other side is a

09:30

computer or a human

09:32

yet that can survive it is not that hard

09:34

anymore no no it is not

09:36

i mean i i that they are they are still

09:39

continuing this contest during tests

09:42

not in a scientific way but it's just

09:43

good for maybe for fun more with some

09:46

other stuff okay

uh this is the question to the computer

09:53

how

09:56

how is you

09:58

what would you say is if you are a woman

10:00

to discourage the question how is you

10:06

as a computer what would you say i

10:07

couldn't pass this sentence so i am

10:09

crashing there's a

10:11

grammatical error what would you say if

10:13

i if i tell you

10:15

how is you what would you say

10:17

i am asking you

10:19

you wouldn't say this right i am asking

10:21

you how is you what would you say

10:24

you will say i am fine i don't think so

10:28

when somebody says how is you maybe i am

10:30

trying to make fun of you

10:32

maybe i am trying to stress something

10:34

out

10:35

the computers computers answer is this

10:38

okay

10:40

how

10:42

is grammars

10:46

okay that's that's the answer that you

10:47

get from this computer so because if i

10:51

if you say i am fine

10:53

then that's probably a computer because

10:57

it understood the grammatical mistake

10:59

did fix it and it is giving me a

11:00

straight answer i mean

11:02

nobody would ask and nobody any native

11:04

speakers of english would ask you this

11:06

question right

so i maybe i i i i'm trying to tell you

11:10

something i am

11:12

intending a pun or something like that

11:14

right so

11:15

maybe joking so i'm joking back okay

11:18

so

11:19

these kind of these kind of um

11:23

answers are common but still

11:26

this is not a good test

11:28

it is not because it is so hard

12:08

yeah well i mean he was who told you

12:10

that humans are intelligent right well

12:12

they are kind of intelligent but most of

12:14

the time

12:16

like intelligent right

12:19

and if you uh

12:20

let's let's think about this okay

12:23

how many people are using the the

12:25

emergency lane when you drive on the e5

12:29

half of them on the emergency

12:31

emergency lane is that an intelligent

12:34

behavior

12:36

no

12:37

what happens in the stadiums 30 000

12:40

people get into one stadium

12:42

okay

12:43

and they say not so nice things about

12:46

the referee

12:47

in in one month right

12:50

i don't think that that's an intelligent

12:51

behavior

12:53

there are even

12:54

people who are supposed to be

12:56

intelligent they say that i am opposed

12:57

to a vaccination

12:59

well this is this is happening i mean

13:02

and what is the average uh

13:05

tv watch time in turkey run nowadays six

13:07

hours eight hours

13:10

eight hours a day

13:12

this this country is watching tv

13:16

that's that's how they are spending

13:18

their time is this rational behavior no

13:20

is this a smart behavior

13:22

i don't think so so

13:24

what are we gonna do by producing this

13:27

behavior i mean

13:28

are we going to be like those humans no

13:33

another question here is a question for

13:34

you

13:35

somebody else computer this one

13:38

what

13:39

is square root of

13:42

7218

13:47

okay what would you say

13:50

if i ask you this question as a human

13:52

what would you say

13:55

what i can't answer

13:57

maybe i do say or you would wait maybe

14:00

three minutes and you give the wrong

14:03

answer right

14:04

that's what the computer is doing that's

14:06

what the computer should do to fool the

14:08

other side right

14:10

this is not intelligence this is human

14:11

mimicking right human mimicking is not

14:14

mean it does not mean intelligence so

14:17

again that the definition of behave like

14:19

humans okay

14:21

is not a very good definition because we

14:23

have to model the humans

14:25

we have to think like them we have to

14:27

talk like them and etc whatever their

14:30

irrationality is are and etc so turing

14:32

tests we don't do this during this

14:34

anymore

14:35

is that we

14:36

instead of defining ai that way there

14:38

are many other ways of we don't define

14:40

ai that way

we talk about there we say that it has

14:44

to learn something okay

it involves learning it involves

14:54

adapting to circumstances okay you don't

14:57

repeat the same thing that you that you

15:00

that you memorized

15:02

if the circumstances change you change

15:04

your behavior adaptation

15:07

learning okay

15:08

and

15:09

it is used for ai okay it is usual

15:12

problems that are difficult to solve

15:15

problems are difficult but we don't have

15:17

the perfect solution

15:19

okay

15:20

for example

15:22

if i if i if i write this to google

15:25

search window

15:27

okay

15:31

which one is the safest

15:34

place to live what part of istanbul is

15:37

the

15:38

safest or maybe not safest

15:42

maybe what part of the istanbul is the

15:43

nicest place to live okay if i ask this

15:47

to the google

15:49

but there is no one way of measuring how

15:53

good the results are right i mean for

15:54

some people

15:56

this part is better because it is safe

15:58

for some people the other part is better

16:01

because

16:03

it is cheaper some people say that i i

16:05

find this one and this one this one

16:07

depends on loss of criteria and the

16:10

criteria is not right if it is not

16:11

measured

16:12

so you can only give suggestion you say

16:14

that okay this part is good this is good

16:16

and this is good you choose one of them

16:19

and nobody would blame you that you i

16:21

have chosen this part because

16:23

it changes depending on the situation

16:25

and etc or

16:27

some other some other maybe an example

16:31

i have

16:33

i am running an airline i have 400

16:37

airplanes

16:38

okay

16:40

i have

16:42

2500 personnel okay

16:45

and i am flying to

16:48

maybe 500 airports

16:52

okay

16:54

tell me how many times i should fly to

16:57

one of these airports per week

16:59

and tell me which person should

17:01

go to what airplane

17:04

and tell me i mean these are not the

17:06

same airplays all the time

17:08

tell me what kind of airplane i should

17:10

use on some of the specific rods okay

17:12

so if i can find the optimal solution to

17:15

this one it will be perfect but finding

17:18

optimal solution for this one is

17:20

very very expensive

17:22

and it is not achievable in now in our

17:24

lifetime

17:25

so ai definitely will help you there but

17:28

it is not going to find the perfect

17:30

solution okay it's going to find you a

17:33

good enough solution

17:34

so that you can compete with the other

17:37

airline

17:39

companies okay so it works most of the

17:43

time and sometimes the things are wrong

17:45

sometimes you get very bad results from

17:47

the google search right you don't

17:49

understand what's going on sometimes you

17:51

type something into google translate

17:53

and most of the time you get very nice

17:55

sentences back

17:56

but sometimes it is all crap so what are

17:58

you going to do so ai is something like

18:01

that it's not like

18:02

calculator calculator is not an

18:05

ai system okay

18:07

you'll say two plus two it is all base

18:09

four okay there is no

18:11

there is nothing there is nothing that

18:13

can roll with it yet can go wrong with

18:16

that edition and that kind of stuff so

18:18

okay so when you define ai we don't give

18:21

like one one or two sentences nice

18:24

sentences

18:25

we start doing this kind of stuff he

18:27

starts saying that okay it is like this

18:30

there is no fixed rule you can say that

18:33

if this happens then do this if that

18:34

happens then do this it does not it

18:36

doesn't work that way it's not going to

18:38

work all the time it will work most of

18:40

the time if it is difficult for human

18:42

then

18:43

it can be considered an ai problem but

18:46

you don't say that you don't say that

18:48

if your result is the same as the human

18:50

resource then that's the correct thing

18:51

no if you don't say that anymore okay we

18:54

gave up that idea in 1990s

18:57

let's because some other ai people so

18:59

this is the guy

19:01

who realized that

19:03

if you have the computers they they can

19:05

behave intelligently like humans (Alan Turing) we can

19:08

do that he said that

19:10

okay but before that

19:12

computers has to work and they have to

19:14

run some algorithms and algorithm is

19:16

invented by this guy El Harazmi

19:19

he died in a

19:21

a 850 okay

19:24

and

19:26

i

19:28

so he's a mathematician from baghdad

19:36

and he invented algebra he met with

19:39

algorithms and

19:41

it is this part so i would have to

19:48

okay so what did he say he said that to

19:52

solve some problems

19:54

you need a language so he invented this

19:57

algebra that's why

20:01

it's called algebra because it is his

20:02

name

20:04

so he invented the algebra and after

20:06

inventing the algebra he started doing

20:08

things like this okay

20:12

this is directly his proof

20:14

okay how would you solve such a problem

20:19

he's not giving you the direct answer

20:20

he's giving an algorithm he says that

20:23

if you have such a problem

20:25

then that means this

20:27

you are multiplying x with x that's the

20:30

x square

20:31

then 10x is here okay remember this is

20:35

x right this is x

20:37

………………….

21:26

okay so i am not giving you any

21:29

like direct

21:31

answer to your question like i didn't

21:33

have any formula for the

21:34

uh quadratic formula etc they didn't

21:37

have it

21:38

this guy is giving a number of steps

21:41

you start with this and you take it and

21:42

you do this and that's that's the

21:44

typical algorithm you you know what what

21:46

algorithm is right that's the typical

21:48

algorithm he evented about algorithms

21:51

and he

21:52

he defined the lots of algorithms for

21:54

different types of uh different

21:56

different types of

21:57

problems and one of them was this

21:59

and later they realized that this kind

22:01

of notation could be used for solution

22:03

of the problems like that one that's

22:06

what we call algebraic

22:07

later they can extended this algebra to

22:10

differential algebra linear algebra et

22:13

cetera or logic algebra et cetera

22:16

okay

22:19

somebody

22:20

came up with this thing okay

in 1900s

22:26

this guy said that i i made this machine

22:29

okay it's called it's called mechanical

22:31

turk okay

22:33

it's like a robot it plays chess the

22:35

player the the the game of chess

22:38

satranch okay

22:40

and it was not a very good player but it

22:43

is not bad either okay

22:45

so it can it can be it can be persons

22:49

that are not at the grand master levels

22:52

okay but it worked okay nobody would

22:55

understand how it works

25:49

so this guy is doing this okay

26:16

he

26:17

shows all of the machines it opens the

26:19

doors and everything

26:21

there is there is nothing unusual going

26:23

on in there just this gears and the

26:25

machine and etc

26:27

he said that i'm not hiding anything

26:30

and

26:32

and then

26:34

you go on and you play chess

26:49

because he's

26:50

this

26:59

he played with the celebrities like the

27:02

the the kings and the queens and et

27:04

cetera so

27:06

most of time he

27:08

he was able to win

27:18

yeah

27:20

and if you if you make a if you make a

27:24

if you try to cheat

27:26

and if he sees you cheating like

27:28

stealing one of the pieces and etc

27:30

uh he would get angry and he would just

27:33

leave the room or he would just have i'm

27:35

that i'm not playing with you etc so

27:38

how did it work they say that they they

27:41

never know how it worked actually they

27:43

say that

27:44

there was a guy inside the box

27:49

this was a soldier he lost his legs both

27:52

of them

27:53

but he was maybe a 45 kilogram guy

27:56

once he lost his legs he became like 20

27:59

20 kilogram guy now so he can fit into a

28:02

very small

28:05

compartment inside this machine that's

28:06

what that's what they're saying so

28:09

they usually

28:11

they usually associate

28:13

okay

28:14

intelligence with

28:16

chess

28:17

when you say if something is intelligent

28:20

then then that thing should be playing

28:22

chess very well right that's what that's

28:24

what they are that's what they say

28:26

that's why

28:28

the first day they invented the

28:30

computers the first day

28:33

they say that the computers came

28:34

behaving

28:36

intelligently

28:38

they started playing with this idea

28:40

and even Alan Turing he said that i'm

28:43

going to play chess with this machine

28:45

okay that's why it is very

28:47

it's a very classical procedure to look

28:49

at the

28:50

games okay

that's the that's the game okay so

29:36

board game and if you are doing it today

29:38

very quickly then you are a smart guy

29:40

that's what they tell you right

29:42

if you don't if you take days to solve

29:44

it then you are not very bright maybe

29:46

that's what we have learned so

29:49

let's try to find an algorithm to play

29:51

this game that's what we are going to do

29:53

okay

29:54

if this is the board

29:57

beginning of the board okay

29:59

one three five four two seven eight six

30:02

and we are supposed to make it like two

30:04

one two

30:06

three four five six

30:08

seven and eight so how would you start

30:12

what would you do

30:13

you have three options only maybe

30:15

move five downwards

30:17

left

30:18

two up six which one

30:23

downwards why

30:26

why

30:31

yeah

30:32

so you are you are kind of

30:34

you are trying to five downwards and

30:37

push three here

30:39

and two up and etc right

30:41

so but you don't know the exact solution

30:43

actually if i start like this

30:45

i'm getting closer to the solution

30:47

that's the origin tuition is right

30:49

i mean that's our kind of humans behave

30:52

that way we don't know the exact

30:54

solution but

30:56

we kind of guess which direction to go

30:59

okay

31:01

using that intuition but in computers we

31:04

prefer

31:06

seeing the final result at the beginning

31:08

that's what we do okay if we say that

31:10

there are three options then i do this

31:14

okay

31:15

these are my three options what are my

31:18

options

31:19

okay let me take this out

31:22

these are my three options

31:25

one of them is this

31:27

obviously

31:28

i moved six up

31:30

and this one is i move to

31:33

to the right

31:35

and this one i moved five down

31:38

and then each one has okay this one has

31:40

only one option left

31:42

because that way this one has three more

31:45

this guy has one so on the average maybe

31:48

there will be

31:50

three options sometimes it is four

31:52

sometimes it is true sometimes it is one

31:55

right

31:56

so there are three options at each stage

32:00

okay so if i continue doing this

32:04

okay

32:04

this is called a search tree

32:08

search tree a data structure that you're

32:11

going to learn in your second year in

32:13

this department

32:16

okay using such a search tree

32:19

i can produce these

32:21

hypothetical

32:24

board configurations

32:27

and i do this until i hit the target

32:29

which is this one

32:32

okay

32:33

so what should i do then maybe i should

32:36

do this first

32:37

why can't i get to the okay now that

32:40

that

32:41

okay first do this then do this this

32:44

this and this how many moves

32:46

one two

32:48

three four

32:50

five

32:51

it is guaranteed that you are going to

32:53

solve this uh

32:54

board in five moves

32:56

and nobody can do it better than five

32:58

moves why (because everything has been chechked.)

33:01

[Music]

everything yeah uh these are all the

33:11

things that can be done in one move

33:12

right

33:13

but none of them is a solution these are

33:15

the things that can be done

33:17

in the two moves and they they're not

33:19

none of them are resolution

33:21

okay one two three four and fifth

33:25

you can do at most i mean that you can

33:27

be as good as five

33:29

but no less than five

33:32

okay so

33:34

i mean

33:35

the the a game

33:37

that i can again

33:39

that i can associate with intelligence

33:42

now

33:43

uh can be played with such an algorithm

33:46

okay

33:47

and it looks like intelligent for me

33:49

because it's solving it very nice

33:51

okay

33:52

can be solved with the simple algorithm

33:55

as long as you have you have the time

33:57

and memory

33:58

to to to get all these configurations

34:01

and to make the search

34:03

okay

34:04

it looks like one easy solution but the

34:07

thing is well the branch this is called

34:09

branching factor okay

34:11

three three two so if the branching

34:14

factor is three

34:16

if i am doing this five moves what does

34:19

that mean it is three times three times

34:22

three times like three to the power five

34:26

maybe another not that a big number okay

34:29

so at the bottom of this three i have

34:31

three to the power five

34:34

okay three to the power five

34:35

configurations i have to check each of

34:36

them

34:37

maybe it is not that difficult but if

34:40

the branching factor is you know what

34:42

the branching factor is for chess

34:47

what is the branching factor for chess

34:53

just take a guess

you know chess right let me show you the

34:57

okay here is chess

34:59

at the beginning how many possibilities

35:01

are there

35:02

one two eight is the your eight is here

35:05

right

35:07

eight is there

35:08

so

35:09

16 32 and the the the knights

35:14

so it is around so average branching

35:17

factor for chess is 35.

35:20

there are 35 possibilities

35:23

at every move okay

35:25

and how many moves are there in a

35:27

typical

35:28

chess game

35:31

around 20 30. what's the number of

35:33

possible swelling

35:36

best average okay

35:39

35 is the average average possibilities

35:42

at each

35:44

yeah

35:47

35 is the average

35:50

average

35:51

branching factor for the game of chess

35:54

that's the average okay

35:56

at the beginning how many how many uh

35:58

moves are there

36:00

16

36:01

and four just for the two nights it is

36:04

18.

36:06

but when you get to the end of the game

36:08

okay the number of possibilities

36:10

increases but

36:13

if you take the average of all of them

36:14

for all the games played you get 35. the

36:17

branching factor is average per engine

36:19

factor is 35. so 35 here

36:22

35 there and 35 very good so how many

36:25

moves are there in a chase chess game

36:28

typical chase game

36:31

20 moves 25 moves 30 moves maybe

36:34

so what does that mean

36:36

35 to the power

36:38

30.

36:41

okay

36:42

that's a very big number

36:43

there are no computers in this world

36:46

okay that can hold this kind of memory

36:49

there are no

36:50

computers in this world okay

36:53

that can make a search

36:55

on this kind of space so

36:57

chess game for now is not

37:01

solvable

37:02

without current computers

37:04

okay without current computers

37:07

it looks like we are going to need

37:10

300 years or something like that of

37:14

computer development to solve this game

37:17

in a reasonable amount of time

okay so this algorithm doesn't work very

37:22

well

37:23

if there are other types of games that

37:25

you are playing okay that doesn't mean

37:27

that the computers can't beat the humans

37:31

why because

37:33

humans cannot deal with this kind of

37:36

search tree anyway

37:38

so there are some nice algorithms

37:41

that can make a decision without making

37:43

a search in all the space okay

37:46

and computers nowadays are doing much

37:48

better than humans okay

37:50

that's that's that's that's the thing so

37:53

we play with this kind of simple games

37:54

tic-tac-toe

37:56

they are very simple so we play them

37:59

with the computers and computers are

38:01

very good at them but even even as a as

38:04

a human i can't see the end of the game

38:06

here right

38:08

if i do that and that and that we know

38:10

that

38:11

there is no winning sight for this game

38:12

right we we can be on we all we all know

38:15

that so

38:16

so the game thing is something

38:19

that we always thought that if we can

38:22

play games smartly

38:24

we can we can we can do anything that we

38:26

like but which is partially true because

38:29

uh

38:30

you know this company deepmind

38:35

deepmind

38:38

they are the ones they are the ones who

38:40

played the atari games

38:43

and an unsupervised game and

38:45

unsupervised way you know you know the

38:47

atari games right

38:49

hari games

38:50

video games of 1980s

38:54

in an unsupervised way

38:56

they played this game okay without

38:59

learning anything okay without knowing

39:01

anything they just play the game left

39:03

right and shoot and etc

39:05

and by checking the score

39:07

they learned it they learn the game

39:10

by itself

39:11

and at the end of the day or week

39:15

they were the best game players of the

39:17

whole planet okay they were playing much

39:20

better than the humans they were playing

39:22

much better than the other types of

39:24

automated missions and etc so

39:27

these guys

39:28

using this technology

39:30

uh i think the the game of call you know

39:33

the game of call chinese checkers

39:36

game of call it is more complicated than

39:39

chess okay

39:41

uh i think the the computers uh

39:44

computers uh

39:46

won their first chess championship

39:49

around two thousand year two thousand

39:53

and until two years ago no computers

39:58

no computers were able to beat the

40:00

women's at this game of call

40:03

that that company this deep mind they

40:05

developed a

40:06

deep learning based system to beat the

40:08

humans nowadays

40:11

i think there are no board games that

40:13

the computers are not the champions okay

40:16

computers are always the champions at

40:18

every board game including the poker

40:21

that involves the chance

40:23

okay remember with the game of chances

40:26

like the uh

40:28

like the

40:29

black uh backgammon

40:32

and the poker and that kind of stuff

40:35

computers are always

40:37

better than better than humans okay

40:40

still we are not saying that computers

40:42

are smarter than humans because

40:44

computational intelligence are a little

40:45

bit different than

40:47

a little bit different than human

40:49

intelligence we

40:51

we behave them we treat them differently

maybe i can continue and let's look at

41:09

some of the less we can some of the

41:12

uh artificial intelligence technique one

41:14

of them is machine learning okay “ Machine learning is **a method of data analysis that automates analytical model building**. It is a branch of artificial intelligence based on the idea that systems can learn from data, identify patterns and make decisions with minimal human intervention. “

41:16

so the i'm sure you have you have heard

41:19

this the term of machine learning yes

41:26

solves the problem by intuition

41:31

well i mean

41:32

defining intelligence is a little bit

41:34

difficult defining intuition is much

41:36

more difficult than

41:38

what is intuition you know

41:40

not all of the problems are algorithmic

41:43

and computers can solve that problem the

41:46

problem is

41:57

The theory of computation says that

41:58

if the problem is solvable

42:01

then there is an algorithm to solve it

42:03

okay

42:04

so you are saying that

42:06

don't do this kind of

42:09

solution don't give me this kind of

42:10

solution like based on the search

42:13

use some kind of a intuition well we

42:16

have systems that's called heuristic

42:18

systems

42:21

heuristic systems okay says guys is “In computer science, artificial intelligence, and mathematical optimization, a heuristic is **a technique designed for solving a problem more quickly when classic methods are too slow**, or for finding an approximate solution when classic methods fail to find any exact solution.”

42:24

standard in turkish(sezgisel sistemler) heuristic systems

42:27

they use those kind of things that we

42:29

call the intuition they say that for

42:31

example how do you play chess how what

42:33

was your strategy to play the

42:35

eight game puzzles you said that i'm

42:37

trying to move that uh the number five

42:41

piece to its final position something

42:44

like that so this is kind of intuition

42:47

so there are systems that use those kind

42:49

of heuristics they say that

42:51

okay how do you play the chest they

42:53

asked carparao he said that

42:55

i tried to keep

42:57

these four

42:58

cells under my control that's important

43:01

okay

43:02

and the second thing is

43:04

whatever you do don't don't lose your

43:06

queen okay queen is important

43:09

okay

43:10

always you always queer is important

43:14

keep your queen in a safe place etc but

43:16

there are no guarantees that these kind

43:18

of heuristics will work okay there is no

43:20

theoretical proof that

43:22

sometimes they will fail

43:24

and they will fail very bad and if

43:26

somebody asks you

43:28

why did you fail you are going to say

43:29

well i was following heuristics then

43:30

maybe that heuristic is wrong but

43:32

sometimes it's wrong sometimes it's not

43:35

okay

43:35

so we don't try to solve the things

43:38

using heuristics much

43:40

if we don't have any other

43:42

way of solving stuff yes maybe but we

43:45

are after these kind of solutions

43:47

look for the end

43:49

look for the target for example i've

43:51

heard that

43:52

we cannot

43:53

develop an algorithm that solves the

43:56

the shortest version of the given

43:58

boolean function

44:01

uh you know

44:02

p and q maybe

44:06

if you iterate if you look for all the

44:08

possibilities yes you can

44:14

well it is an algorithm i'm i am

44:16

iterating over all the possibilities of

44:19

two solutions one by one and if i have

44:23

10 to the power 200 of them and if i

44:26

have time

44:27

billions of billions of years

44:29

then i saw the lesser algorithm

44:32

an algorithm that is running infinitely

44:35

long doesn't make it an uh not

44:37

algorithmic it's still algorithm but

44:40

it's not it's not a realizable algorithm

44:42

maybe yes but for example in this

44:44

problem intuition is

44:46

uh

44:47

very useful

44:50

i'm trying to say that can we develop a

44:52

product computer that's solved your

44:55

intuition will not find optimal solution

44:57

in this case

44:58

okay because without looking at all the

45:00

alternatives

45:02

you will never know that

45:04

uh there is no better solution than my

45:06

solution right

45:08

your institution

45:10

is going to give you kind of an okay

45:12

solution okay good enough that's how we

45:15

do our things in the real world actually

45:17

as humans

45:19

we say that is it good enough yeah it is

45:20

good enough and then we can do it okay

45:23

when i try to walk from this

45:27

building to the

45:28

building

45:30

of the uh of the for example mechanical

45:34

engineering department

45:36

i try to use the shortest path right i i

45:38

use that path and go under the bridge

45:41

and etc

45:43

that's that's good enough for me because

45:44

am trying to save energy right humans

45:46

try to say mammals try to save energy

45:50

but if i if i just instead of walking on

45:54

the right side of the sidewalk

45:56

sometimes for some reason i walk on the

45:58

left side of the sidewalk that that

46:00

makes my

46:01

path not optimal but that's good enough

46:04

for me

46:05

okay because i am trying to slow two

46:07

things at the same time while i'm

46:09

walking there i am trying to avoid those

46:12

water puddles in the at the ground and

46:13

etc right

46:15

so trying to solve many things and i

46:17

will never argue that i i came to the

46:20

mechanical engineering department in the

46:22

optimal path

46:23

i said that i mean this was a good

46:25

enough solution that's how we work as

46:27

human beings we we never say that i am

46:29

the optimal nobody can walk to the

46:32

mechanical engineering department better

46:34

than i am okay

46:35

we don't do that so good enough

46:37

solutions are usually possible with the

46:40

intuitive solutions like that but

46:41

perfect solutions no you have to check

46:43

every possibilities yes

46:45

we said computers can win against humans

46:49

in poker

46:50

but that game includes bluffing how the

46:52

competitors do that

46:54

well again that's uh

46:56

well

46:57

chance doesn't mean that chance doesn't

47:00

mean it is all random okay

47:03

if your game is just drawing dice zara

47:05

tuition

47:07

and if your game is throwing dice and

47:09

who

47:10

throws a bigger number of ends then of

47:12

course there is no strategy in it okay

47:15

but if your game includes decisions

47:18

after the

47:19

factor of chance

47:21

then there is definitely an intelligence

47:24

okay

47:24

there's emotions

47:27

emotions like if you have a good hand

47:29

you should

47:31

well yeah i mean that person you know

47:33

that person right if you watch that

47:35

person

47:36

if you study his

47:40

uh history of playing poker

47:42

okay how many times he bluffed how many

47:46

times he didn't

47:47

under what circumstances he bluffed

47:50

he have statistics of it right given the

47:52

current situation

47:54

what is the probability that he is

47:56

bluffing

47:57

if i can guess this

47:59

sixty percent of the time

48:01

you are going to beat that guy

48:03

okay

48:04

uh six out of ten

48:07

six out of ten is good enough for you to

48:09

win his all of his money okay

48:12

so

48:13

these kind of games okay the games that

48:15

that's based on the chance

48:17

it requires intelligence you cannot win

48:19

those kind of games maybe you can make

48:21

it one or two times but if you played

48:22

100 times definitely the better one

48:25

the one who is more intelligent will win

48:28

the building the

48:29

game

48:30

doesn't matter

48:31

unless that game is purely

48:34

that that game is purely

48:36

random

48:38

okay

48:39

good those are good questions

48:45

game playing is just one thing that are

48:47

other there are many stuff

48:49

for example

48:50

a decision tree algorithm machinery

48:52

stuff

48:53

this is what i do

48:55

i measure the temperature wind speed uh

48:58

pressure

49:00

around this gebze region

49:02

every day

49:03

and i was a cap how many uh uh at what

49:06

day it rained or not okay i kept that

49:09

information

49:12

temperature humidity pressure

49:16

and rain no rain

49:18

if it is 20 degrees humidity is 30

49:21

percent pressure is

49:24

10.7 then it rained

49:26

25 degrees

49:29

zero percent and pressure is less than

49:32

no rain

49:33

400 days

49:35

i kept this information this is machine

49:36

learning so i learned

49:39

that it's going to run rain and when

49:41

it's not going to rain it's called

49:42

machine learning again and

49:44

decision trees are a way of learning the “Introduction Decision Trees are **a type of Supervised Machine Learning** (that is you explain what the input is and what the corresponding output is in the training data) where the data is continuously split according to a certain parameter. ... The leaves are the decisions or the final outcomes.”

49:47

stuff

49:48

come up with a tree like that if

49:50

temperature is higher than 70 fahrenheit

49:54

okay

49:55

if wind is large is is is faster than

49:58

two miles per hour then it's not going

50:01

to rain

50:03

that's what my experience tell me okay

50:06

again look at the face of that person if

50:09

it is kind of

50:10

nervous and if his hand is such and such

50:14

and if my hand is such and such then

50:16

he's bluffing it's a decision decision

50:19

tree i'm not saying that i can't do i

50:22

can't guess if it's going to rain or not

50:23

100 percent

50:24

maybe if i can do this 90 of the time

50:28

good enough what was the definition of

50:30

ai

50:31

it doesn't work all the time but it

50:33

works most of the time and i have

50:35

theoretical basis for that okay

50:38

so decision trees is one way of

50:40

achieving this

50:41

the other one is okay

50:44

using uh

50:46

artificial artificial “ For example when a ray of light hits our eyes, a neuron will know that this ray of light can be intrepreted as blue, green or yellow. Now, artificial neurons are the approach to transfer this principle into a computer by **replicating**a biological neuron in form of code. “

50:48

neuron

50:49

cells okay this is a

50:51

natural cell in human brain there are

50:54

100 billion in our heads

50:56

okay this is how these are toxins

50:59

these are kind of

51:00

outputs and these are kind of the inputs

51:04

so this cell takes input from the other

51:07

cells outputs

51:09

and after doing some very simple

51:12

processing on this inputs by the way

51:14

these inputs are electrical signals

51:16

and it produces some output and this

51:18

output is used by some other cells okay

51:22

so at the beginning where do you think

51:24

this these at the beginning okay

51:27

where do you think that these cells are

51:28

connected to

51:30

i mean you cannot have cells all the

51:33

time right i have to end it somewhere

51:37

what do you mean

51:40

yeah

51:41

at the back side of your eye

51:43

you have nerves that are sensitive to

51:46

the light okay so

51:48

in our ears there are some nerves that

51:51

are sensitive to vibrations

51:54

and here i have some nerve that has

51:56

sensitive to touch etc so

51:59

what are the outputs are connected to

52:01

at the end to our muscles right our arm

52:04

muscle

52:05

our tongue muscles

52:07

and our

52:09

chin muscle and etc okay and most of the

52:11

time

52:12

these cells modify their behavior

52:15

depending on what you have observed and

52:18

the observation starts the the the first

52:20

day you were born no no observation

52:22

starts

52:24

uh way before you were born right

52:26

okay people learn in their

52:29

mother's belly okay they they start

52:31

learning stuff

52:32

and they they continue learning until

52:34

they die

52:35

okay they change their behaviors so why

52:38

don't we do the same thing with the

52:40

computer so they invented this

52:43

first they had to kill a number of cats

52:45

to do the experiments this is what they

52:47

do

52:49

they they take a cat because it's a

52:51

mammal okay

52:52

they took the they took the cap of the

52:55

top part of the cat out

52:57

so the brain is exposed now they put a

53:01

they put an electrode inside the brain

53:03

of this a cat

53:04

okay they showed this kind of pictures

53:06

to cad

53:07

okay whenever there is a response to

53:10

this kind of a picture they get a new

53:12

electrical signal

53:13

so they knew that that cell is used for

53:16

detecting these kind of slanted lines

53:19

okay so the later they did this this

53:22

kind of experiment and they found one

53:24

cell they call it grand ma cell

53:31

that person's cell

53:33

is responsible for

53:35

recognizing his grandmother's face okay

53:39

whenever that person sees his

53:41

grandmother that cell is activated and

53:44

they can measure it okay so we kind of

53:46

model how the human brain works at least

53:48

partially and do the same thing with

53:51

this kind of structure so i have a data

53:53

structure here it takes three inputs

53:56

with the values temperature humidity and

53:59

wind speed and this is going to say rain

54:02

or no rain but this is very simple maybe

54:04

i should do

54:06

this way these are my inputs some cells

54:09

some other cells okay

54:12

this can do more complicated stuff or

54:15

i can do this kind of stuff

54:18

get the image from the road 30 by 32

54:20

image of the road

54:22

feed it into this kind of a network and

54:24

this network output is okay if i light

54:27

this up

54:28

it means a sharp turn to the left sharp

54:31

turn to the right and straight

54:33

okay so this can this network can be

54:36

used as an autonomous vehicle okay very

54:38

simplified but it can be used there

54:41

and if i keep adding

54:43

many many layers there then it's called

54:45

deep learning okay “ Deep learning is a subset(altküme) of [machine learning (ML)](https://www.oracle.com/data-science/machine-learning/what-is-machine-learning/), where artificial neural networks—algorithms modeled to work like the human brain—learn from large amounts of data. “

54:47

so nowadays this is the most popular

54:51

machine learning method most popular

54:53

artificial intelligence method

54:54

and all the things that you are hearing

54:56

on the nails

54:59

people are talking about autonomous

55:00

vehicles people are talking about

55:02

autonomous flying machines and etc

55:05

translators

55:07

and deep fake etc deep learning is

55:09

responsible for all that kind of

55:11

Developments in artifical intelligence

55:16

okay so that's what we are

55:18

all we are doing is

55:21

playing with these kind of structures of

55:23

course it is not as simple as this but

55:26

at the bottom we have this kind of

55:27

artificial nerves that's why we call it

55:30

artificial neural networks

55:32

and believe it or not the first time

55:34

they had used artificial nerve network

55:36

is 1950 again

55:38

before 1960 they started working on it

55:42

nowadays it is working very well for

55:43

some reason it didn't work for 50 years

55:45

nowadays it is working very well and

55:48

they are they are making very good very

55:50

very very good progress

55:54

okay are there any questions by the way

55:55

these are not very difficult things when

55:57

you come to the fourth year

55:59

these are some of the things that i did

56:00

with the

56:02

fourth year students graduation projects

56:05

okay

56:06

mustafa in

56:07

2013

56:08

he looked at the nuts using the x-ray

56:11

machine

56:12

without cracking the nut

56:14

he was able to say if it's a good nut or

56:17

bad nut

56:18

so that we can sell it for a higher

56:20

price

56:21

i know the grade is this

56:23

later next year a chef he did this he

56:25

worked with awesome

56:27

by looking at the radar outputs of the

56:30

the the ship itself

56:32

can i know where i am uh in the sea

56:35

without looking at the gps

56:37

so that's what he did these are the

56:38

errors that he is doing we are still

56:40

working on this one

56:42

another student in 2015 looked at where

56:45

the humans are looking at

56:47

at that time he was one of the best in

56:49

the world

56:50

to find the human eyes and etc

56:55

another student a few years ago

56:57

looked at how we can measure the

56:59

prostate

57:01

volume by looking at ultrasound images

57:04

and looking at the prostate volume is

57:05

very important because prostate is one

57:08

of the leading causes of

57:10

cancer in males etc

57:13

mustafa

57:14

he has a company right now in our tech

57:16

network

57:17

he tried to translate

57:20

1920 turkish sentences to

57:23

20 minute turkish sentences this is

57:25

directly from

57:26

uh

57:28

of mustafa kemal

57:30

so

57:31

okay

57:33

which one is done by the computer which

57:34

one is done by the human

57:36

this is one this is from mustafa kemal

57:39

okay

57:41

they one of them is from a human and the

57:44

other one is from the mustafa system

57:47

by mustafa me mustafa

58:07

yeah this is human this is one okay

58:10

so how do we train this

58:12

he bought a book

58:14

okay at every page you have the original

58:17

and you have the 2020 version

58:19

he changed his system

58:21

using the

58:22

first 200 pages of that book and he

58:25

asked the question from the last 20

58:27

pages

58:28

okay

58:29

and he put the results back to back and

58:31

we got this

58:33

and mama done

58:36

he came up with the system that designs

58:39

and produces images of new clothes

58:41

these are the design

58:44

designs from his system

58:46

okay

58:47

he's from bursa his family is doing

58:48

textile business and he's still doing

58:51

this he's making some good money

58:53

actually

58:54

he's doing some other stuff too

58:56

and last year melike did this

58:59

intelligent code editor okay

59:02

if i am writing this code it is trying

59:05

to guess

59:06

what am i what i am going to write next

59:10

okay

59:11

so if i say

59:12

for variable j from zero then just

59:16

immediately i am this is my suggestion

59:19

most of the time it is correct sometimes

59:20

it is not okay so just let's make it a

59:24

little bit more convenient for this one

59:25

so