Title: 공학도를 위한 생물학 (1)

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[00:00]

Science has developed technology.

Main title Biology for Engineers which is for engineers to inspire biology in their needs.

?[00:15]

I don't know many of...hoping, I hope we can, ?[00:25] works so…

I don't know if any of you know about the shut down of ?[00:35].

So there are many reasons to study brain, you know, the problems you already know…

Why brains are interesting, so on…

One thing intersting is that simply you don't understand all the…

And there are actually many progess made ?[01:09].

Particularly in terms of the mechanisms of brain.

The molecules are involved, how the information move from one part of the brain, sensory, referring, through to the motor of our body.

?[01:29] understood about proportional function…

Basic proportional principal laboratory reports.

And if we, hardly do, evidence that we don't really know that as in fact, we can'd develop very successful producing our technologies.
We can't know the machines do, the brain can't.

It's not just that the machines don't do the human brain.

We can't know machines do what ?[02:00], the very simple, and else.

So even though very simple animals resemble our functions.

And one of the most popular explanations is this, is just nerve system very complex.

So there are many different types of nerve models.

First very large ?[02:28] than human brain, ?[00:30] the types of nerves.

Some of these are shown here ?[02:35] now hundred of years old.

And each of these nuerons have its own action to recover properties.

There are each point that has ?[02:48]

They also have the other electrical properties that are different from the other.

And so, popular engineers they just keep studying nerve system ?[03:00], I mean.

They continue to better and better understand the structure of nerve system.

They eventually as to understand more and more, reflect the complexity and perhaps the functions started to be.
?[03:21].

But we know that the entire nerve system develops from ?[03:32] nerve system, the entire form.

It develops from single cell.

So here just is a single neuron.

And I think it's possible, it's my own view, that all the types have their different activity that they may all of quite similar properties.

Somehow, the neurons are selected so, snap connections, as selects its own ?[04:10].

And I think each nueron may follow similar rules, and it does that.

And so, we understand the function, so many basic functions similar on ?[04:28] on these ?[04:30] our own system functions.
So, actually I said something about what is on ?[04:45].

Some of professors here ?[04:51] how actually different neuro science ?[04:54].

Neurophysiology is to study biological function at levels from cells to the organisms.

[05:00]

And that seems quite broad, that physiology is not studying the structure of biological systems.

Of course you have to understand functions, you have to know something about your...

But physiology is normal biological functions, not structure.

So other areas of neuroscience, which are not neurophysiology, are Molecular Neuroscience, Developmental Neuroscience, Neuroananomy, and Psychological Nueroscience, Neuropsychology.

The contents of this Course, the three parts of this course.

The first part is electrical properties of nueronal membranes.

So there are great intimation in their membrane voltage.

And membrane voltage is actually o?[06:22].

So the first to know anything about nerve system, is very important first to understand electrical properties of neuronal membranes.

And the second part of the course talks of functions of synaps.

That is the connection between neurons ?[06:51].

And then finally study systems of brain, that is networks of neurons.

And this… typically in this section, I'll talk about computational principles, the power of networks of organisms.

And in this course partially overlap with the introducton to Neurobiology course taught in Biology Department.

?[07:36] less general, more specilalized course.

So you know, we have some overlap go more detail than physiology.

And there will be other areas that will not be covered ?[06:53] of neuroscience.

So I won't spend much time on anatomy or on different regions of the brain.

So not this part of brain is this, this part is something else, I won't spend much time.

And the main, final reason I am not wanting to do that is…

Different neurons and different regions of brain have different functions.

But the main reason of this is simply because they posses different information.

It's not, it do not necessarily mean, the function accords to different principles.

So the focus on this course is on the basic principles of neurofunction.

So the different sensor system for example, is the evidence that they function according to public principles.

And so I would like to focus on one sensory system and particular ?[9:06] to the bigger system.

We just studied very detailed.

And during ?[9:21] course I will try to emphasize organizaion flow of infromation to nerve system, mechanisms and ?[09:37]molecular? something about the information ?[9:44].

The textbook Bear, Connors, and Paradiso, 3rd edition.

This is the same textbook that was uesed to , have been used to ?[10:03] course particullarly the introduction of biology course, rather than just teaching biology part.
[10:00]

I might have choosen to use Campbell's textbook.

But a new edition of the textbook is coming out the next spring.

?[10:26]and I'm getting tricky for to buy a text book ?[10:27] be outdated

So I'm not ?[10:32] of this basically ?[10:36] textbooks doesn't change much.

Anyway, so we are using this textbook, and as splited into four parts

Part one, basic foundations.

The most of the section will be covered in this course, sepecially chapter 3 to 5.

The second part is of sensory motor syestems.

And I'm focused, as I said visual system, infact I am.

And I will ?[11:19] both and I do cover ?[11:21] system would be covered in somewhat very detailed rather than in the book.

So the some material, the smaller material, ?[11:30] on textbook.

Addition to couple of baisal systems by main, but sometimes of other sensory systems, and you have motor system

And another, but some I'm not trying to cover every system, not every sensory system.

And in part three is of brain behavior.

Which I think is very intresting topic, and I've studied behavior.

But i'm not planing to cover this section.

And in part four is the chainging brains.

So how brine motors in changes, and ?[12:28]

And that I will be covering that section especially chapters 23 and 25.

So learning and the neural plasticity system.

And as i said some of the lecture material will be not come from the textbook, so ?[12:54] a 10% materials ?[12:59] the textbook.

So if you were to come to lectures, I will make the powerpoint preservations ?[13:12] to ?[13:14]

The lectures are all in video taped, was not my idea.

But, in any case, the entire vedio will be available to...

That's ?[13:35]

I have chose to have 3 exams.

And the reason for that is, the other I minor reason was that, by further might be conflected that midterms and finals with other courses.

But I'm opened to changing the number of exams if you have, there is general ancister matter up too.

So be ?[14:31] two exams,?[14:35] ,I suppose ?[14:38] right now

So how many of you would prefer to have two exams instad of three?

Nobody? anyone wants to speak out from ?[14:59]

[15:00]

So prerequisites it's very important to have prior knowledge of cellular and molecular biology.

So neurons are cells just like, mostly like any other cells, upon...

They have the chemisty is simillar to the chemistry of others.

And so you don't have any knowledgy about cellular molecular biology, you are going to have some lot of troubles of this course.

And I can't, I can spend some extra time with some people, but I can't really teach basic science of molecular biology.

However, you don't need to have any prior knowledge of neuroscience.

So you never had neuroscience course before, that's O.K.

And perhaps I should have,

That I mentioned there is some over-lap and this course with the introduction neurobiology course.

And perhaps with some of the other science courses.?[16:27]

But my hope is, my intention is that this course will be sufficiently different from thoes courses that will still be useful if you were to have that courses.

And particular that is by focusing more on physiology by both cellular systems and on.

So I thought that I should say something about my own biographs.

I have bachelor's degree and Ph.D. for neuroscience in programs were quite, mostly ?[17:22] science.
But after that time I have studied system's neurophysiology behavior.

And that became more of ?[17:33]

And just before coming here I was working as post-doc at Stanford.

And that years that I have studied past, my Ph.D work was microphysiological reports of dopamin neurons in rat brain slices.

So dophamine is a neurotransmitter and there's a small number of [?18:04] of the brain that have that transmitter.

And in this case, a slice of the rat brain [?18:15] has this neurotransmitter and [?18:17] has been reported.

And in studies [?18:21] oncology.

After that I performed the electro-[?18:28] reportings [?18:30] in behavior of primates.

So it's the same neurology but very different level of study.

And then I've recently published one theoretical paper basically describing analogy, how I think the brain might work.

A list of publications already booked.

My current research interests are…

One of my many interests is in, stil lin dopamine neurons and dopamine's effects on neural plasticity.

Dopamine is…very important for…how the brain processes reward informations, how it learns about new order, how behavior is connected towards reward.
[?19:34]

Another area of interest, perhaps my main area of interest now is in rules that determine neuron's inputs.
Of course neuron's input determines its output.

At different neurons have different inputs so I might understand rules of each neuron's likely input.

[20:00]

And neuron has…a lot of inputs are synaptic inputs and these are talked about a lot, studied a lot.

It also has non-synaptic inputs.

These are…mediated by glial channels.

The activity of these channels depends on the passage activity or output of neuron.

And in general, very basic idea, that is the general framework for my work is that the goal of each neuron is to predict the state of a part of the world that is closely associated with the animal's biological goals.

So another way of saying that is that each neuron so different mention that is related to the animals biological goals.

And the…the animal needs that information in order to select its output, that is to choose, choose the actions that are better for the animal.

Use that information for that purpose.

What I would…what I'm working on now is test the hypothesis that many different neurons select their inputs according to the same rules.

And neurons, neurons differ from one another because the statistical structure of their synaptic inputs differ.

Or another way of saying that is the neurons develop in different environments.

So they may all develop according to the same rules or principles but each neuron rose up or develops in different environments.

And so they have the different [?22:12], they have different information.

And then the ultimate goal, my goal and perhaps of many other people in neurology is to understand the brain well enough to be able to build artifical intelligence.

And currently, we don't know enough, I think it's generally agreed we don't know enough now to do that.

There was a period about fifty years ago when a number of discoveries were made in neural science, in information theory and…research into some very basic mechanisms of the brain such as action potentials.

And people, at that time people were quite often just that there'd be a lot of progress in artifical intelligence.

And they wrote science fiction, there was a lot of science fiction that came out about that.

But it hasn't, it hasn't progressed rapidly since that time.

But I do think that it's, it's something that will happen eventually and…and that's perhaps the most basic motivation for my work.

And hopefully I'll be able to [?23:45] about that in this course all over.

Of course we'll focus primarily just on basic…basic physiological mechanisms.

And I guess I might add a lot the attempts to develop artifical intelligence... have not…

Some of the attempts have…have tried pretty…some of the basic agreements in biology but not been very thorough or realistic either.

And other, other attempts to develop artificial intelligence have not, have not been basic biology at all.

They tried to do it wthout, without any understanding or effort to understand them right.

So that's essentially all I have for today.

One other thing I'd like to say is that…

I, I have read the books and I have had the experience that Korean students don't ask questions.

[25:00]

And, and perhaps you consider it rude asking questions because maybe, if you're asking questions, you must be because the professor didn't explain it very well.

In the United States, it's, it's considered to be a bad day when students don't ask questions because it indicates that the students are not interested in that period.

But I want to encourage asking questions not just to flatter me but to interested in the materials.

But to help better understanding, to help need to know…one part if I'm not explaining very well, you know there will be some things I don't explain very well.

And also…so that I can teach you about the things you're interested in.

There may be somethings that go beyond, you can question things that go beyond the lecture material but I'm happy to explain, to provide additional informations if I can.

So please ask questions and actually I might, there are ways I might have to try to force you to ask questions.

One thing I did last class semester was to have, several times of course I had you all write a list of questions on a piece of paper.

But that was rather helpful and many just write whatever you like but you're expected to write something.
Okay?

Are there any questions?

Any questions about the contents of the course or the grade policies?

(Student speaking) I just have a question of your new thesis, why you got the [?27:27] specific thesis about dopamine.

(Student speaking) So you're looking at dopamine where, I'm not too [?27:34] are there certain characteristics or neurons what you're looking for?

(Student speaking) I guess dopamine again, layered, [?27:45], neurons?

Why did I originally study dopamine or…

(Student speaking) Yeah.

Why do I think it's interesting now?

(Student speaking) It's what, because I'm at the stage where I'm just starting myself so yeah, I'm trying to see why you're interested in it or…

I mean, I'm originally interested in dopamine because…I'm studying it at the cellular level if I wasn't studying behavior, I'm just studying cellular neural physiology.

But dopamine is…dopamine neurons are unusual because it's just a small number of them but they have very powerful influence over the behavior.

So dopamine…dopamine I suppose is a strong on behavior.

And if you destroy dopamine neurons, you have Parkinsons' disease where a person can't move very well.
And all of the addictive drugs, all activate dopamine one way or another.

They have different mechanisms but they all increase [?29:00].

And…and there's a lot of evidence including some of my own work that indicates that dopamine teaches the brain about reward.

Or teaches the brain about how to get the reward without perhaps to avoid bad things.

So it's very, even when you study dopamine, it's not about [?29:36].

It's relatively easy to relate, relate the work of the side of them to, all to behavior, at least compared to many other [?29:47].

So that was why I actually wanted to study dopamine.

And now I think what's a reason to study dopamine is just in the whole entire brain is functions to…it's all related to reward.
[30:00]

At least if you divide it into very more broadly.

So it's a, biological roles of the airport as I might condition it.

You can define its biological roles…by [?30:33] and the function of the brain is to put up those goals.
And it launches that unconsciously.

But all the information that the brain gets is somehow related to…these biological roles and to promoting those roles which I now use the term reward in a broad sense.

And so dopamine is not the only neurotransmitter, it's important to know that there's many others well, at least several others.

But dopamine has a bit of the best study and there's, there are currently very good occupational models, the physiological models for how dopamine performs that function.

I'm interested in testing those, that is these models.

Any other questions?

Well, like I said, the powerpoint presentation and also the video will be available on the last website that someone…I need to…I'll have to be sure that happens.

I don't know…I'm not sure that I'll be able to provide…all the powerpoint presentations before lectures.

It'll probably be best if I could do that but…there's a very good chance I won't have them prepared entirely until right before the lectures.

So I could give you partial versions or…it doesn't quite match beforehand.

But certainly, certainly before the exam all that information will be available to you.

Okay?

Okay.

Thank you.

[?33:05] questions I have, how many of you are graduates?

Okay.

Just five of you are graduates.

How, how many of you are in this department?

Okay, how many in biology department?

Okay.

Anyone who's from chemistry department?

Aerospace engineering?

Alright, thank you.