ADVANCES IN GENETIC ENGINEERING AND THE FUTURE OF HUMAN KIND

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This talk presents 1) the latest advances in genetic engineering (GE); 2) applications on Humans; 3) outlook to the future.

Advances in Genetic Engineering (GE)

Applications of GE on Humans

Conclusions + Outlook
Genetic Engineering (aka GE, Genetic Manipulation, or Genetic Modification)...

Genetic engineering is defined as the direct manipulation of an organism’s genes including heritable and nonheritable recombinant DNA constructs.

From: Laboratory Animals, 2014

D.J. Harris, in International Encyclopedia of the Social & Behavioral Sciences, 2001

The term ‘genetic engineering’ stands for human alteration of the genetic code of an organism, so that its biosynthetic properties are changed. The major applications are for the...

...is the manipulation of genetic material by either molecular biological techniques or by selective breeding --Schildkraut, in Encyclopedia of Genetics, 2001
What is the state-of-the-art of Genetic Engineering techniques?

How to find the latest advances in Genetic Engineering?

http://matt.might.net/articles/phd-school-in-pictures/
A Systematic Review and Tertiary Study of Genetic Engineering


Find primary studies in Google Scholar. Then ``Snowballing’’
To change or not to change: (A) Genetic modification; (B) No genetic change but put a silencing mark

(A) Genetic modification

(B) A new technology tested on plants: deposit silencing marks on a gene, thus preventing its use.

http://sitn.hms.harvard.edu/flash/2015/epigenetics-in-plant-breeding/
New Platform Transforms The Latest Gene Editor Into Precision Tool: from Clipping Scissors to Word Processor

In other words, we can say from CRISPR to CRISPR++

Barcodes are used in a new way in the latest Gene Editing platform, adding a new level of precision to gene editing.

Application Domains of Genome Engineering

- Drug development
- Animal models
- Genetic variation
- Gene surgery
- Medical
- Biology
- Biotech
- Food
- Materials
- Fuel
Application 1: In 2015, a first-of-its-kind Genome Sequence-Based Screening for early detection of Genetic-caused disorders.

Genome Sequence-Based Screening for Childhood Risk and Newborn Illness

http://www.genomes2people.org/babyseqproject/

Can screen for approximately 30 heritable, treatable conditions such as blood disorders, allowing for more personalized and preventative healthcare.
Application 2: Gene therapy/surgery

Gene surgery involves inserting copies of a normal allele into the chromosomes of an individual who carries a faulty allele.
In 2015, CRISPR used to remove HIV from living cells in the lab. Early 2016, the 1st clinical trial for CRISPR Cancer Treatment

What Gene Surgery can do: Curing Genetic Diseases, and even “Century” Diseases such as HIV, Cancer to Their Roots

Obesity, Autism are also on the list...
Application 3: Rewriting Life by Engineering the Perfect Baby

Scientists are developing ways to edit the DNA of tomorrow’s children. Should they stop before it’s too late?
Genetic Engineering Will Change Everything Forever – CRISPR

Youtube Video:

Genetic Engineering Will Change Everything Forever – CRISPR: https://www.youtube.com/watch?v=jAhjPd4uNFY
The "Insane Good": Enjoy the ability to resist diseases, tailor your baby, and be forever young!? 

In 2015, Guoping Feng, a biologist at MIT’s McGovern Institute, predicted actual gene-edited humans are “10 to 20 years away.”

Ethical and societal questions: Is this a path toward a dystopia of superpeople and designer babies for those who can afford it?
CRISPR bombshell: Chinese researcher claims to have created gene-edited twins

Lulu and Nana controversy:
https://en.wikipedia.org/wiki/Lulu_and_Nana_controversy

The clinical project was conducted secretly until November 2018

He Jankui told The Associated Press that he carried out his experiment to protect the twin sisters from HIV infection later in life. MARK SCHIEFELBEIN/AP PHOTO
China’s CRISPR twins might have had their brains inadvertently enhanced

New research suggests that a controversial gene-editing experiment to make children resistant to HIV may also have enhanced their ability to learn and form memories.

by Antonio Regalado
China’s CRISPR babies could face earlier death

A genetic mutation that protects against HIV leads to a shorter life span, researchers find.

by Antonio Regalado
CRISPR++ has significantly increased the precision in gene surgery. But doing it in reproductive cells or very-early embryos means ...?! 

“Side effects” are unpredictable, especially in the long run! The whole human gene pool will be changed irreversibly, forever!
‘We as a species need to come to terms’ with CRISPR technology as China awaits birth of third genetically modified baby
Extreme: OvaScience had an idea of combining gene editing techniques with unfolding discoveries related to stem cells.

Some investors got an early view of the technique on December 17th, 2014, at the Benjamin Hotel in Manhattan, during commercial presentations by OvaScience. It made the presentations as part of a successful effort to raise $132 million in new capital during January, 2015.

The recipe goes like this: First, edit the genes of the stem cells. Second, turn them into an egg or sperm. Third, produce an offspring.
Summary of some key GE techniques and applications

Latest Gene Editors have the precision comparable to "Word Processor".

Genome Sequence-Based Screening for early detection of Genetic Diseases is available.

Gene Therapy is more possible.

"Designer Babies" already in 2018! What's next: Forever Young!

Jurassik Park: Combining Latest Gene Editing Techniques with Stem Cells!

Are humans truly playing "Gods" now?

Thomas A. Edison
"Hell, there are no rules here-- we're trying to accomplish something."
What's in it for us, as global citizens?

Genetic Manipulation of Human is prohibited now. But, ... actual gene-edited humans may be just “10 to 20 years away”.

There’s no single authority that speaks for science, and no easy way to put the genie back in the bottle.

“This is not the end, it is not even the beginning of the end, maybe it is the end of the beginning” (Winston Churchill).

Keep an eye out for future updates!
What can Software Engineering/Computer Science get inspired from Genetic Engineering/Biology?

Mutation Testing

Genetic Algorithms

_DiversifyIT for securing IoT world!

Keep our mind open, thinking out of the box, go interdisciplinary!
Genetic Engineering has provided great inspirations for Hollywood movies...
Mutation Testing is a type of software testing where we mutate (change) certain statements in the source code and check if the test cases are able to find the errors.
Genetic Algorithm

What is Genetic Algorithm?

- Follows steps inspired by the biological processes of evolution.
- Follow the idea of **SURVIVAL OF THE FITTEST** - Better and better solutions evolve from previous generations until a near optimal solution is obtained.
DiversIT: Diversity for securing digital infrastructures

The DiversIT interdisciplinary approach proposed by Dr. Brice Morin (SINTEF) in a recent project proposal.
Main References

- [The future of human genome editing](https://www.nature.com/articles/ng.3860)
Main References (cont.)

- Genetic Engineering Will Change Everything Forever – CRISPR: https://www.youtube.com/watch?v=jAhjPd4uNFY
Technology for a better society