Biophysical Modeling for Cultured Meat

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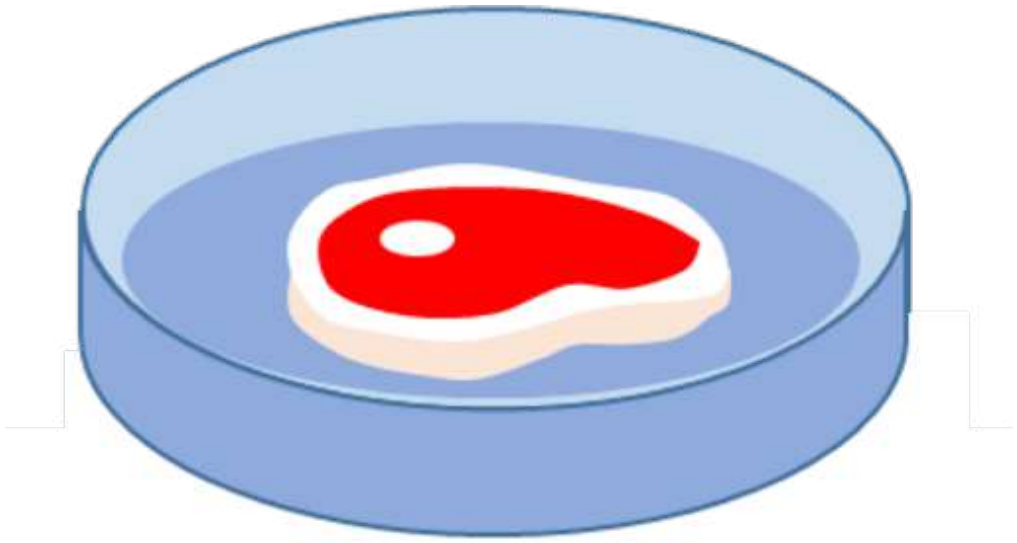

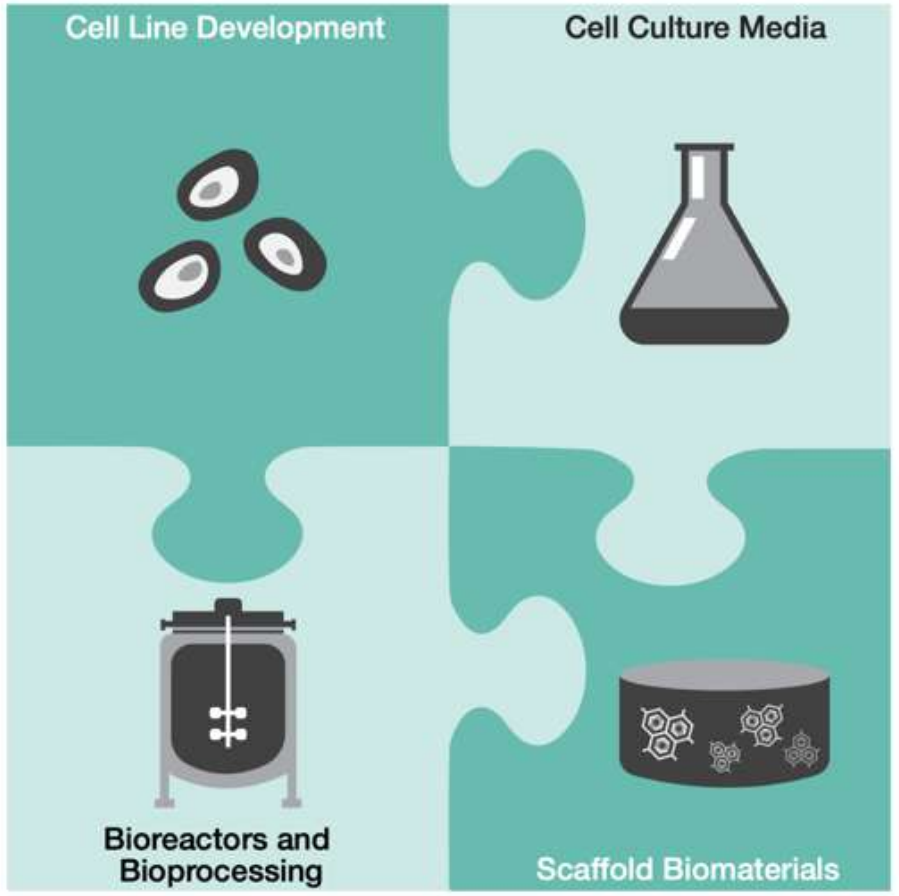

Biophysical Modeling for Cultured Meat

- What is meat?

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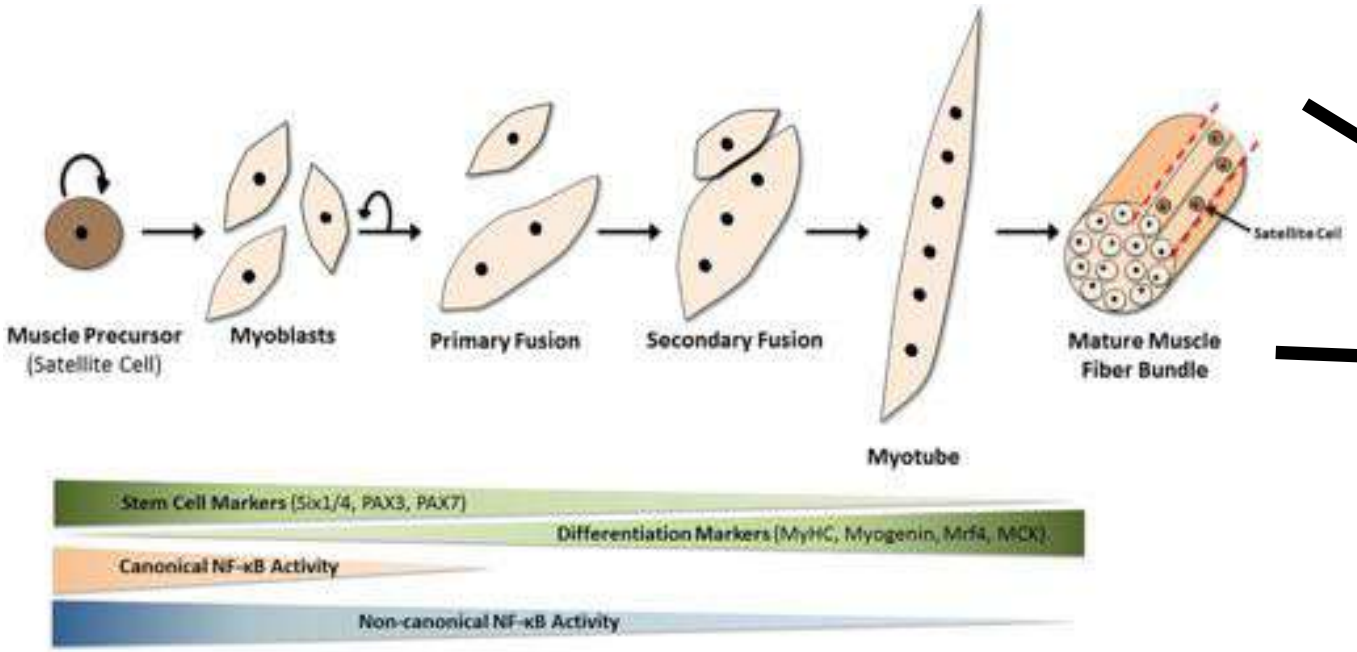
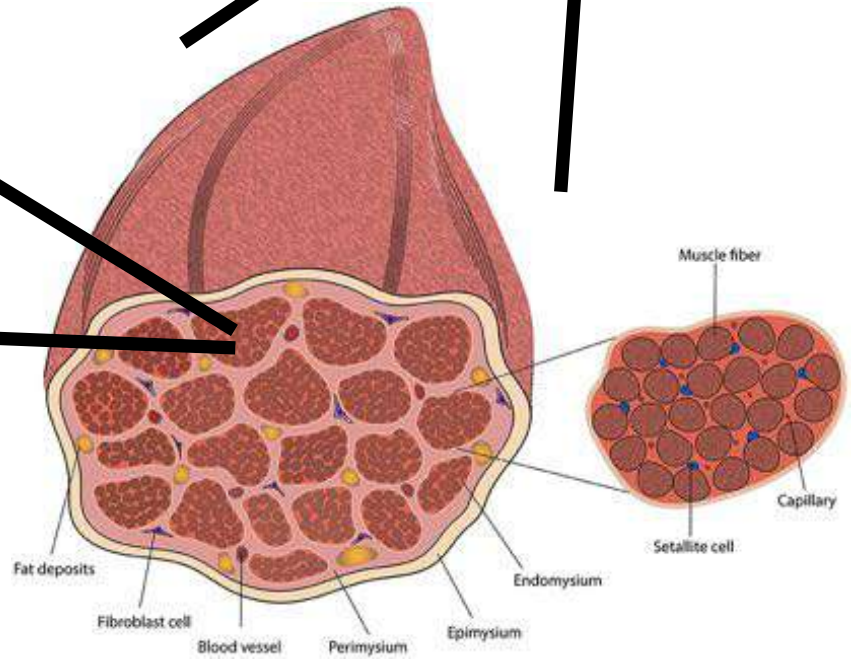
- What is meat?
- Striated muscle fibers
- plus fat cells, connective tissues, blood vessels





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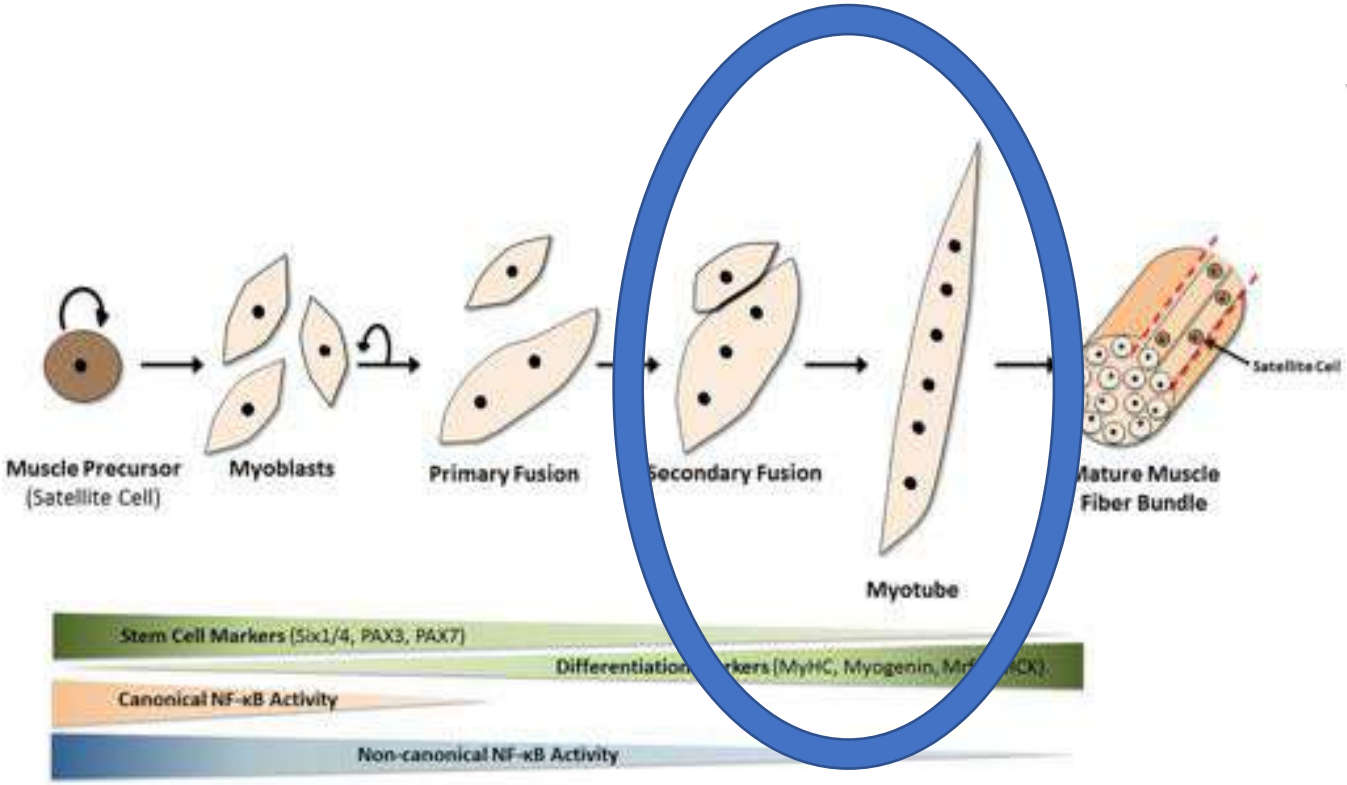

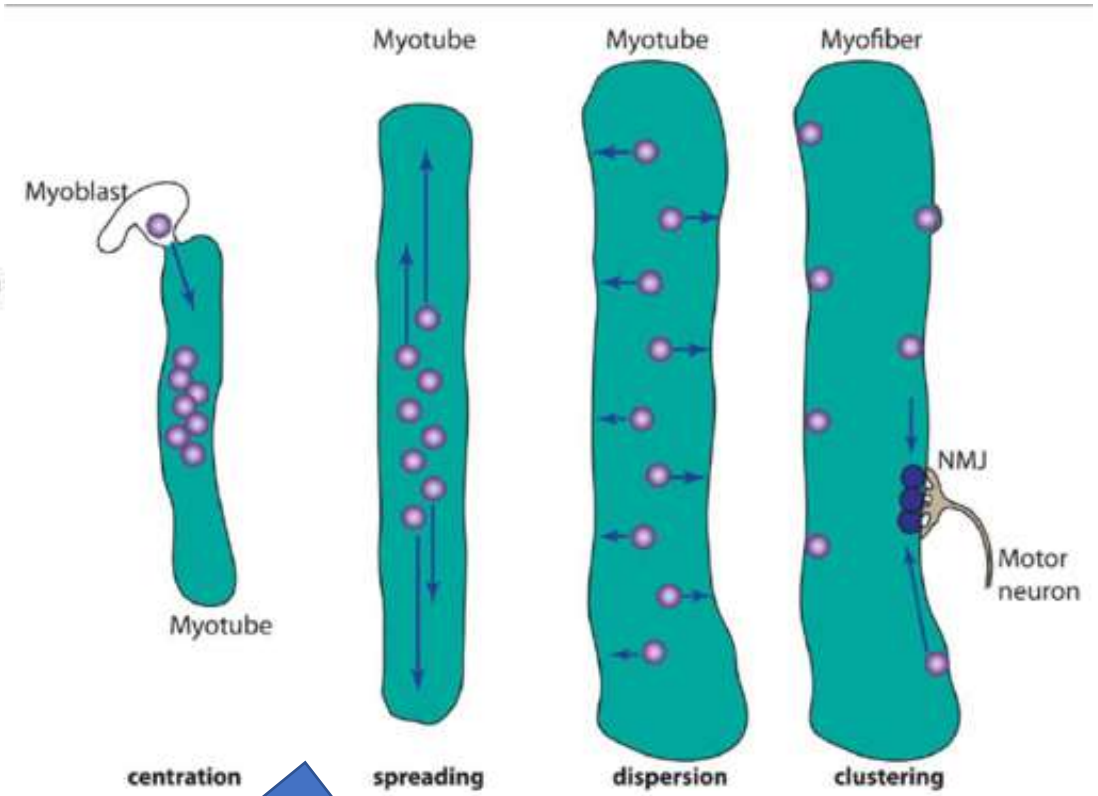

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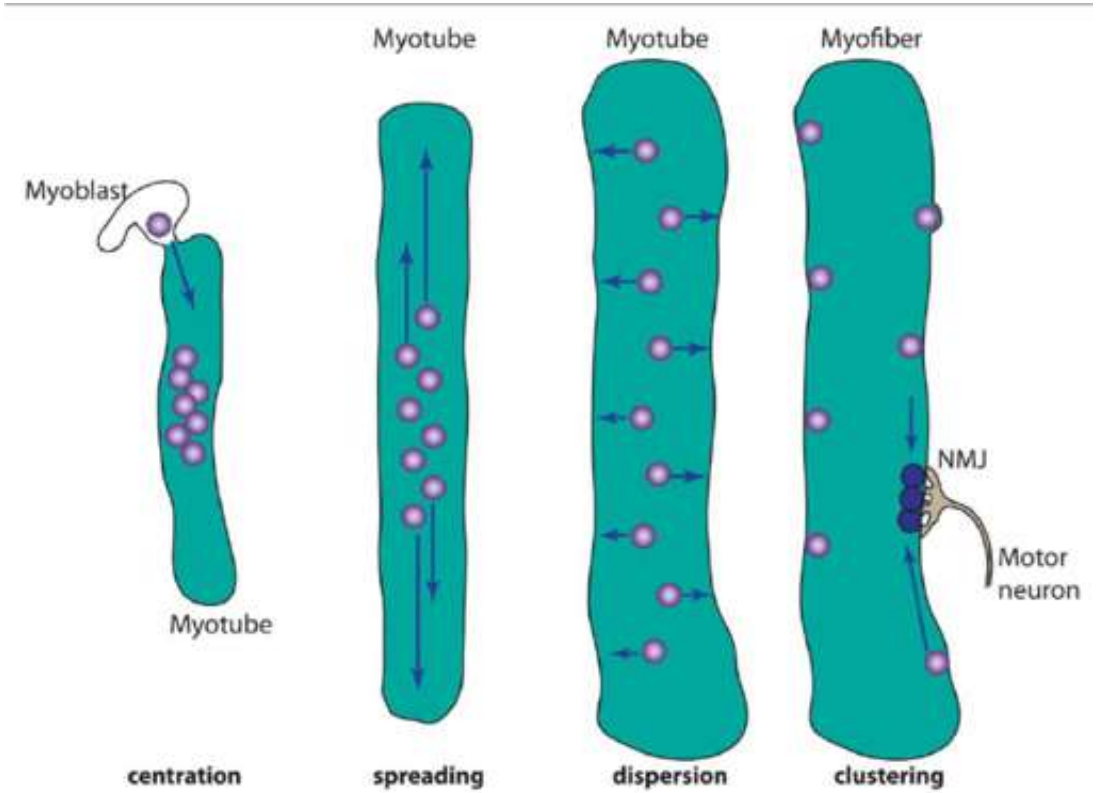
- Question: What is the mechanism of nuclear positioning?

- Understanding this will allow us to control muscle fiber formation in cultured meat production



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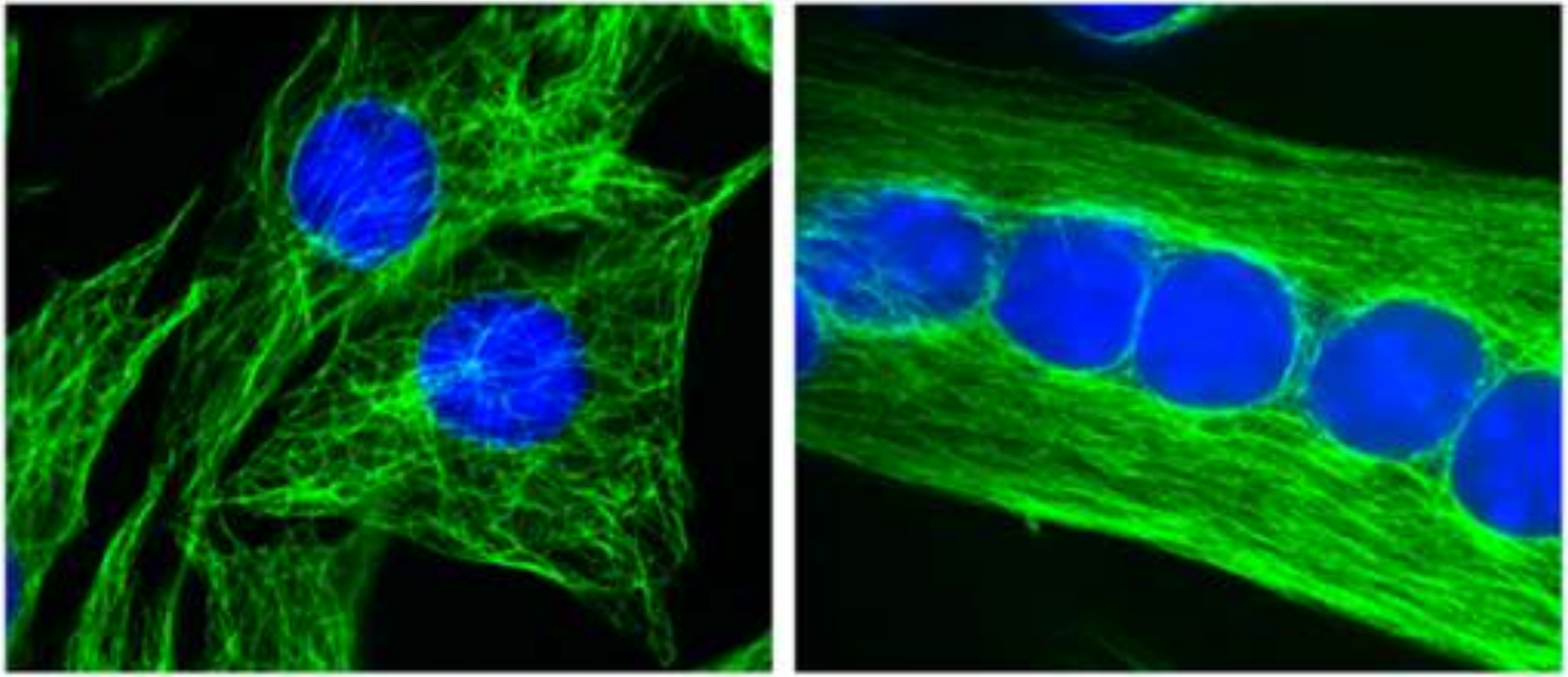

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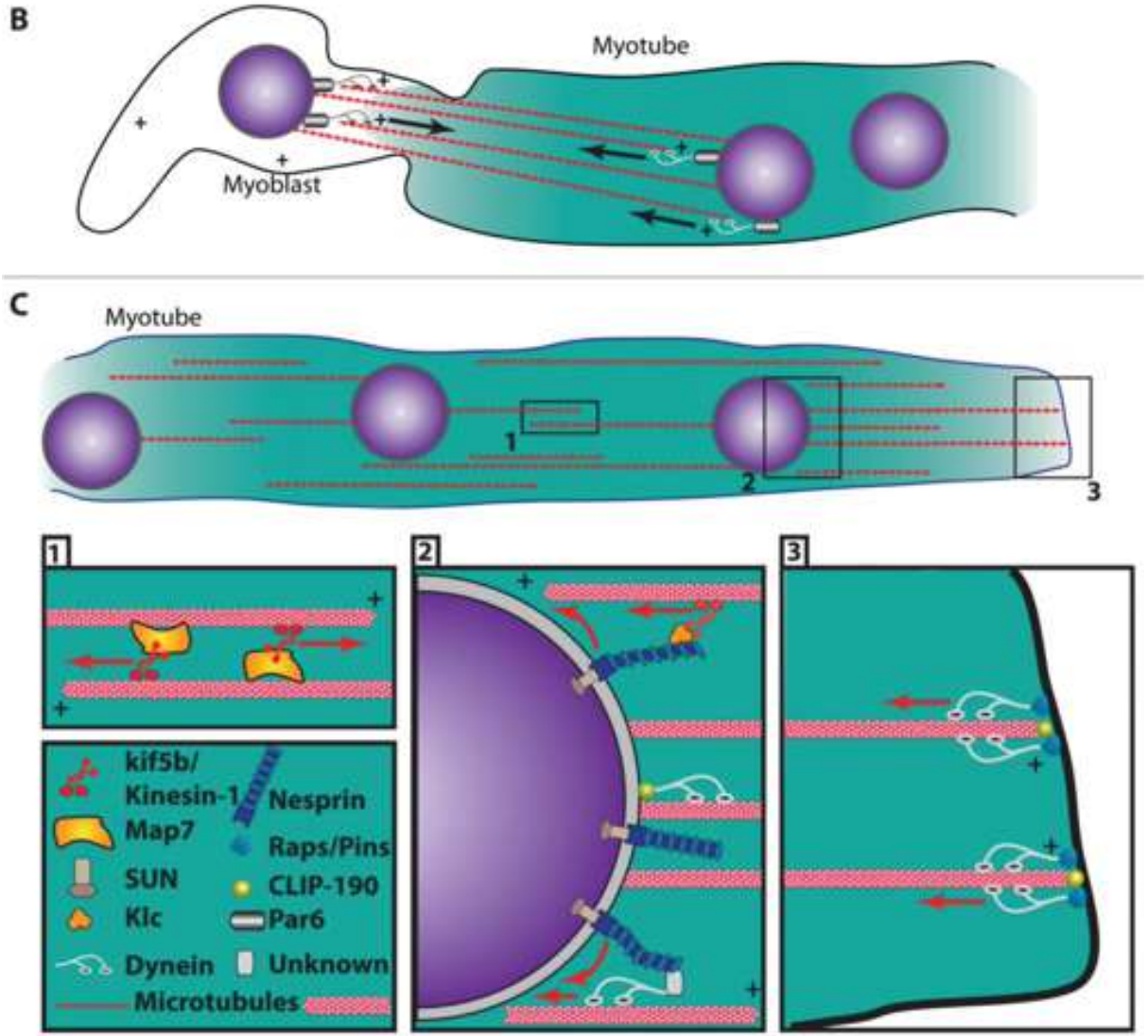
- Question: What is the mechanism of nuclear positioning?

- Answer:
  - Microtubules play important role,
  - together with microtubule motors (dynein and kinesin), and
  - microtubule associated proteins (e.g., Par6 and MAP7)
  - nuclear envelope proteins (e.g., Nesprin, SUN)



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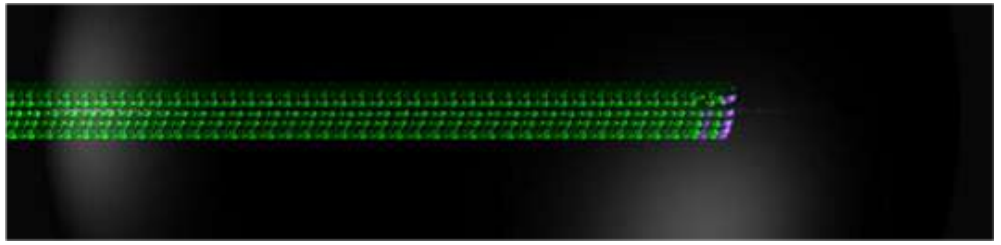
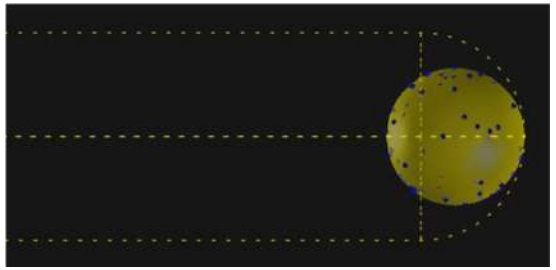
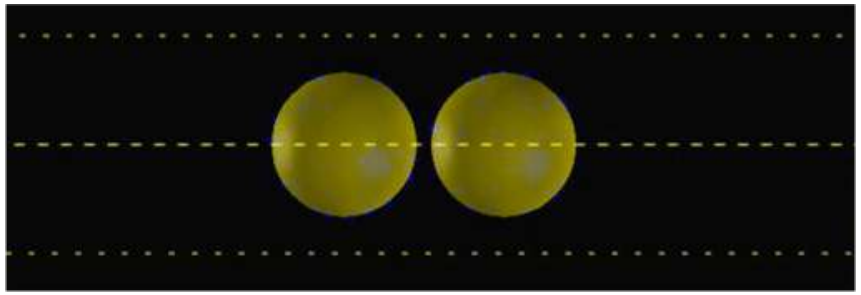
- Ingredients:
  - Microtubule dynamic instability
  - Par6-dynein complexes push against cell cortex
  - MAP7-kinesin complexes push against neighboring nuclei







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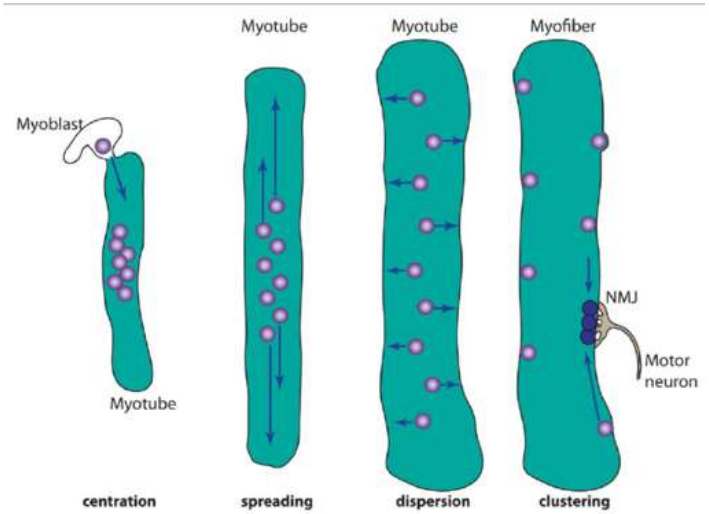
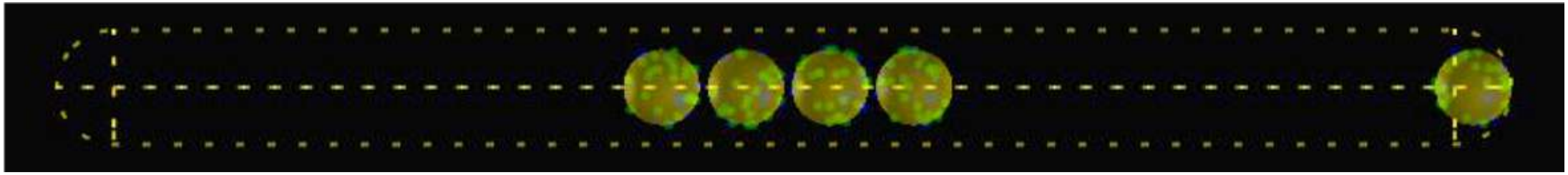
- Centration is driven by Par6-dynein complexes exerting pushing forces against cell cortex





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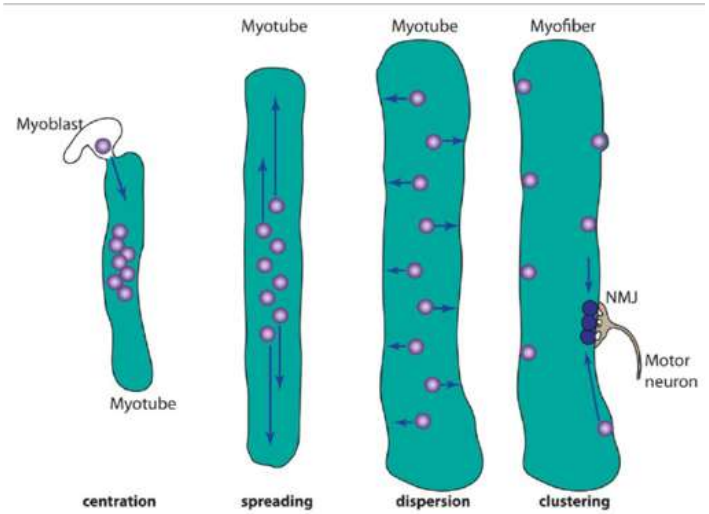
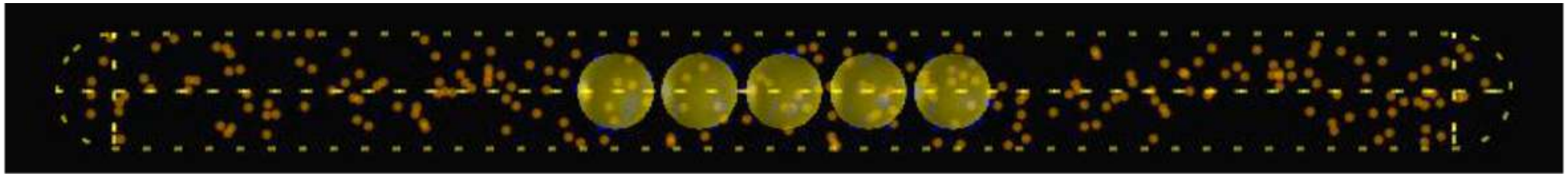
- Spreading is driven by MAP7-kinesin complexes exerting pushing forces against neighboring nuclei





Biophysical Modeling for Cultured Meat

- Formulation of culture media for novel cell types
- Must be serum-free

- Example: 7 possible factors, each of 4 possible doses
- Total number of possible alternatives = 4^7 = 16,384

- Example: 15 possible factors, each of 4 possible doses
- Total number of possible alternatives = 4^{15} = 1,073,741,824

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- Formulation of serum-free culture media

  =

- Finding the combination of factors and dosages that optimizes cell count and cost

- Belongs to a class of computational problems called **combinatorial optimization**

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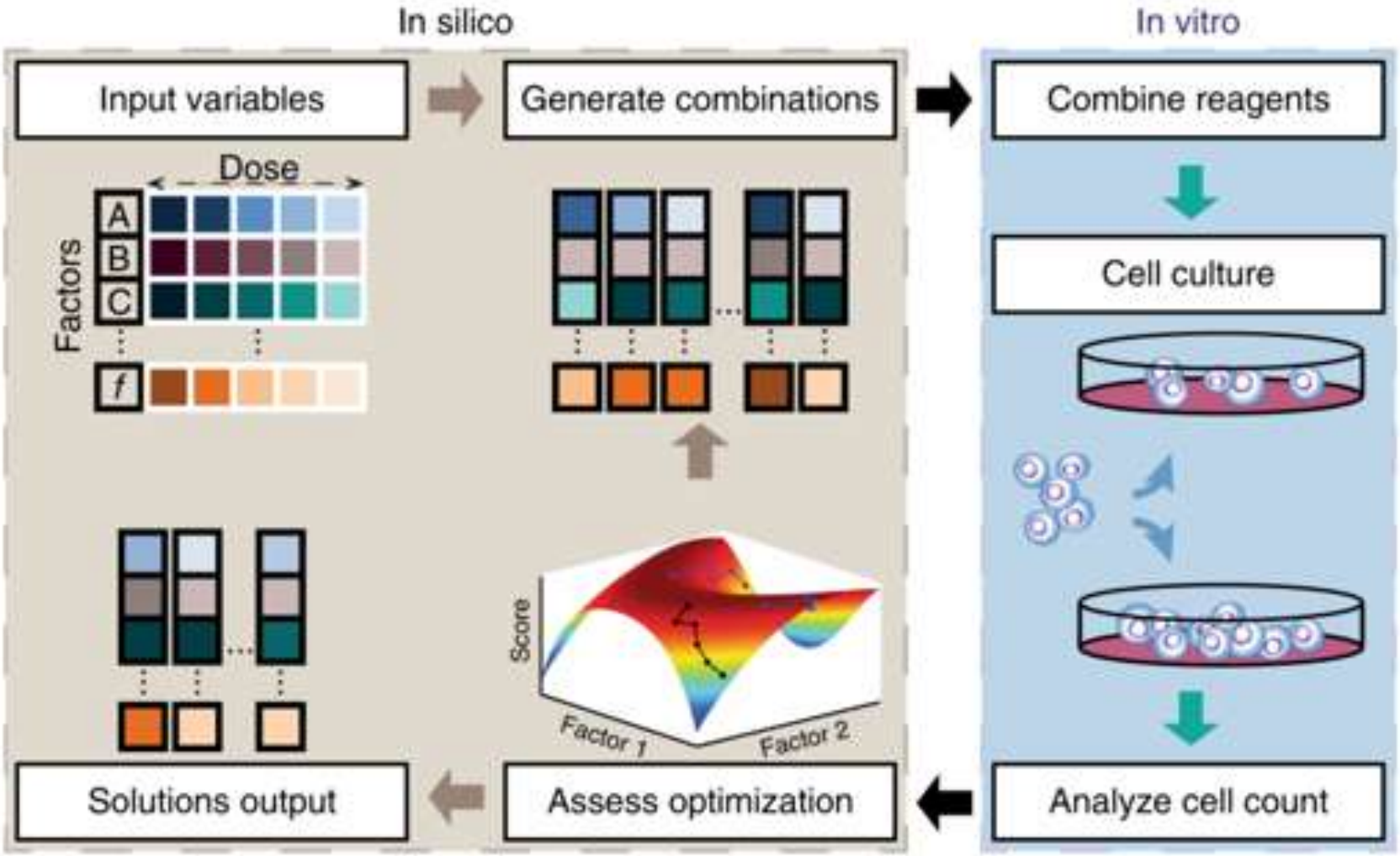

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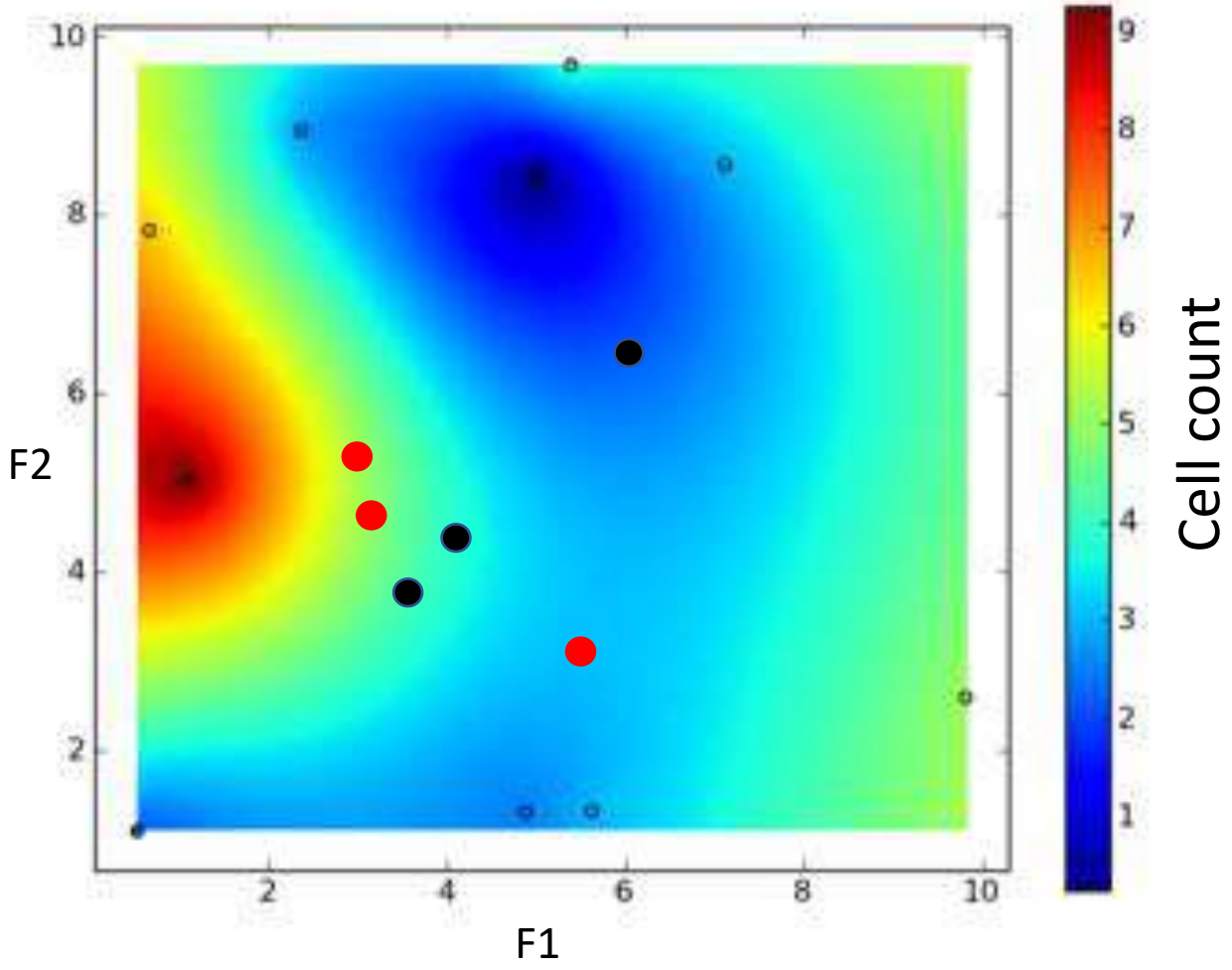
- Iterative search: Differential evolution
  - Iteratively improve the next combination by evolving it
  - Does not use the gradient
  - Maintain a population of candidate solutions
  - Create new candidate solutions by combining existing ones
  - Keep those that have the best fitness



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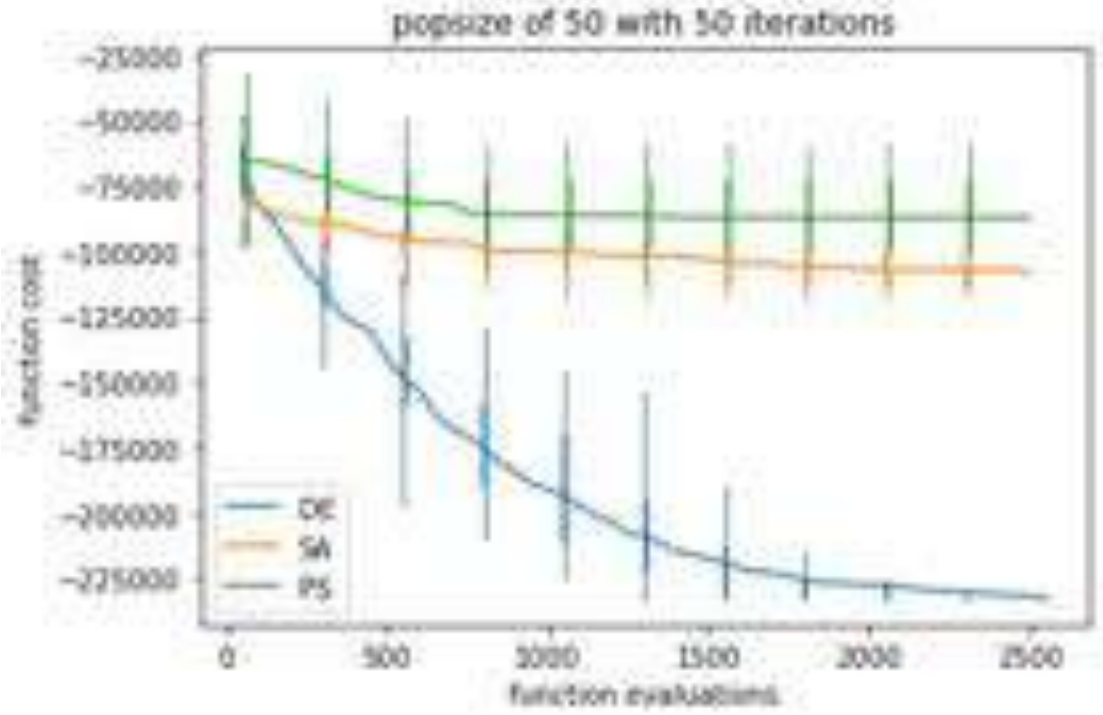

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