

Soft Robotic Approach to Food Material Handling

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APCRAS 2020, May 26, 2020

Agenda

- **Why Food Industry ?**
- Soft Grippers
- Introduction of SIP

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Lunch Box (Bento)



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Food Industry

<https://www.youtube.com/watch?v=LmPjKW7cPB0>

Lunch Box Production: Several millions / day
Production: near market (Tokyo, Osaka, ...)
Big sakes in the morning, i.e., packing at night
Completely depend on humans but difficult to secure them

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Food Industry

<https://www.youtube.com/watch?v=LmPjKW7cPB0>

Many soft foods
Large variation in shapes and properties
Often change products
High accuracy is not required

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Current Automation Technology

Highly accurate dimensions
Accurate positioning
Numerical control (NC)
Environment control

Uncertain shapes, dimensions,
and positioning
should cope with uncertainties

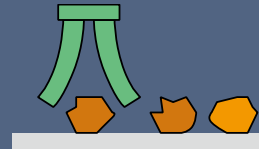
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Approach: Soft Robotics

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Approach: Soft Robotics

Coping with uncertainties
based on soft robotics
approaches



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Why Food Industry ?

Current automation technology is not applicable

General barrier against automation

large variation in shapes and properties
large-item, variational-scale production
many small to medium sized companies

Develop technology could be applied to
distribution and agriculture (and vice versa)

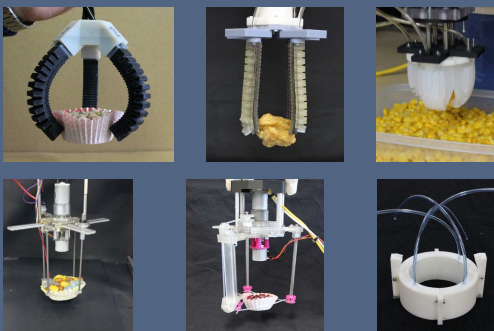
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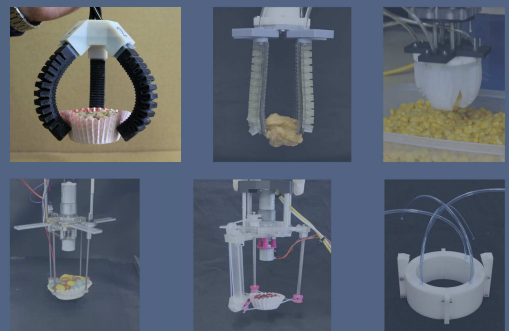
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Soft Grippers



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Printable Gripper



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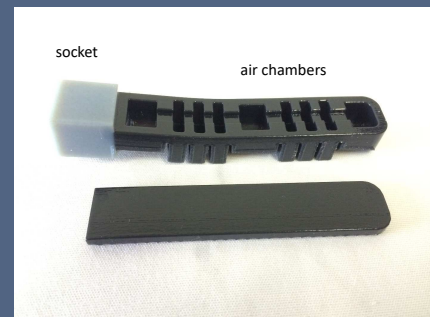
Printable Gripper



Wang et al., Robotics and Biomimetics, 2017

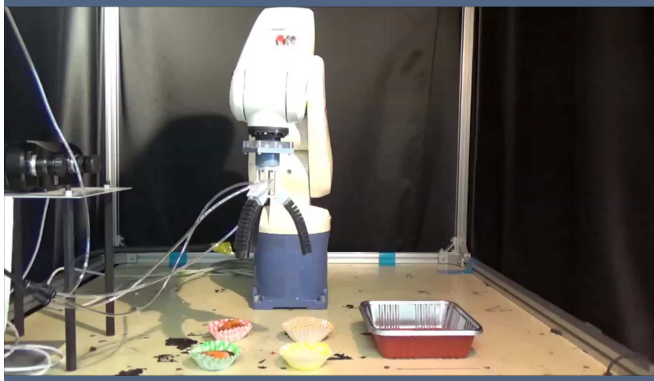
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Printable Gripper

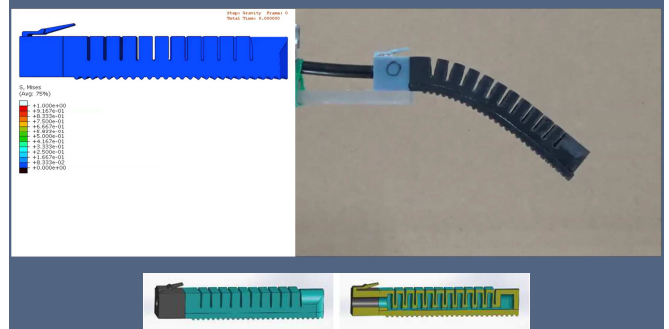


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Printable Gripper

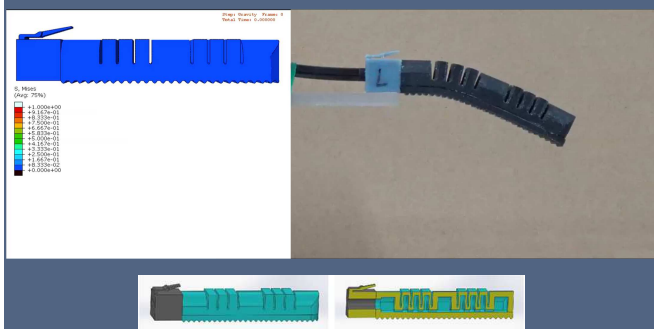


Printable Gripper



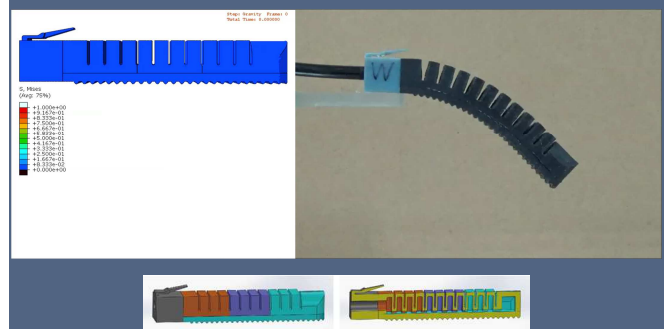
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Printable Gripper



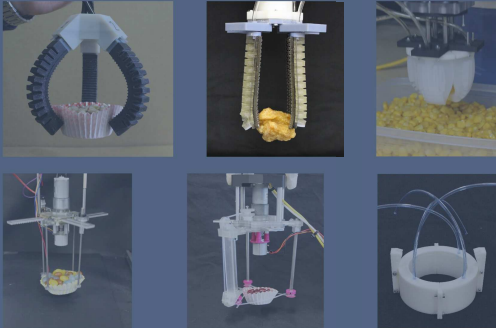
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Printable Gripper



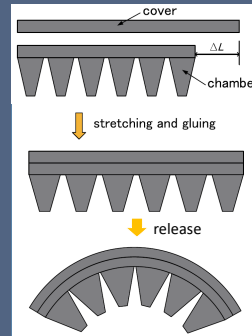
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Prestretched Finger Hand



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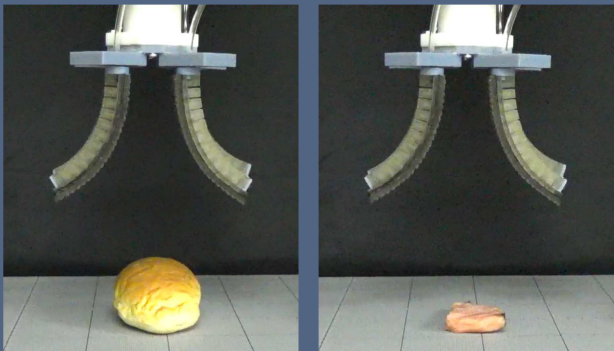
Prestretched Finger Hand



Wang et al., IEEE RAL, 2017

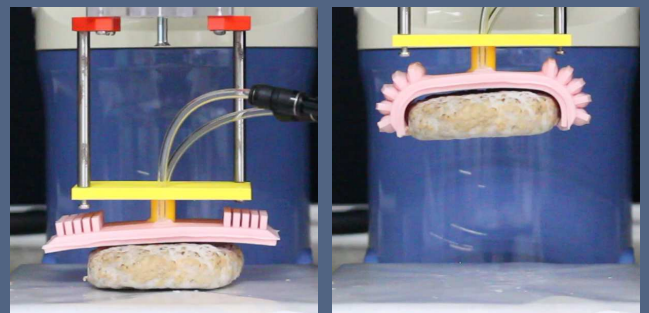
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Prestretched Finger Hand



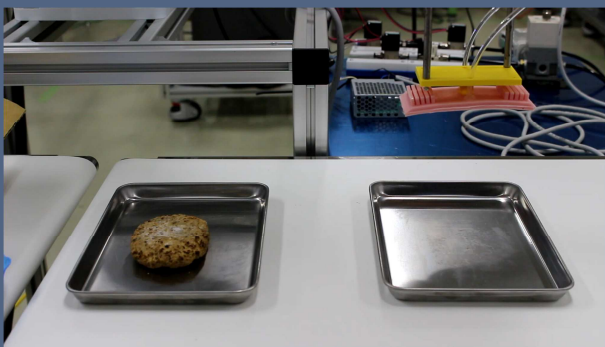
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Flat Gripper



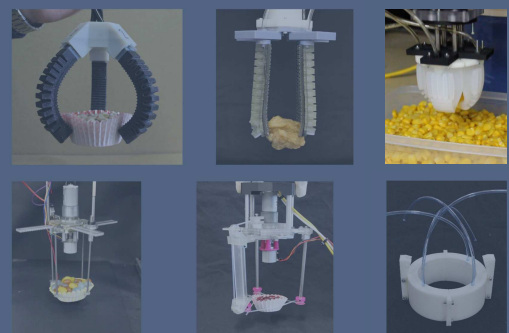
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Flat Gripper



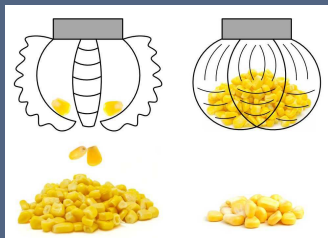
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Wrapping Gripper



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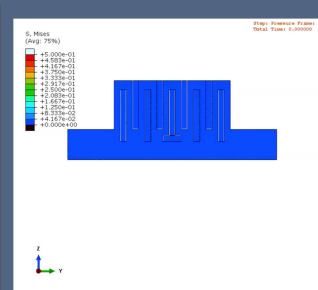
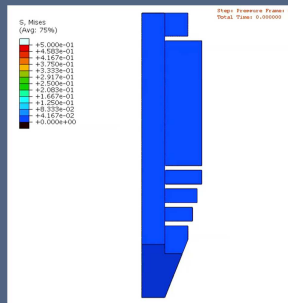
Wrapping Gripper



Kuriyama et al., IEEE RoboSoft 2019

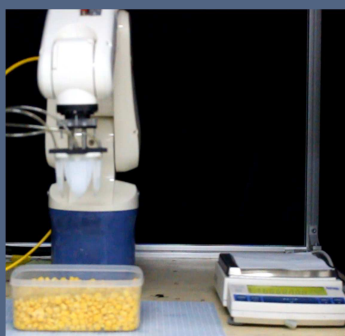
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Wrapping Gripper



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Wrapping Gripper



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Wrapping Gripper



chopped vegetable



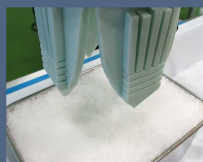
seaweed

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Wrapping Gripper



pickles



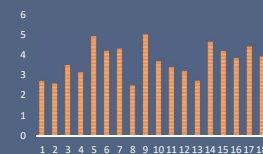
salt

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Wrapping Gripper

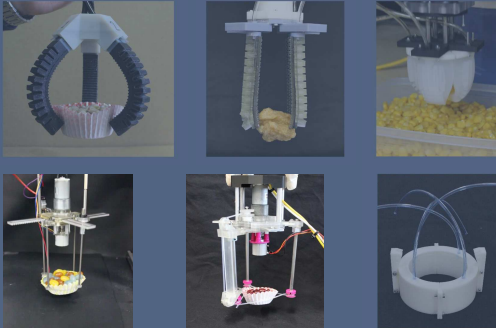


depth image controls the motion of the gripper



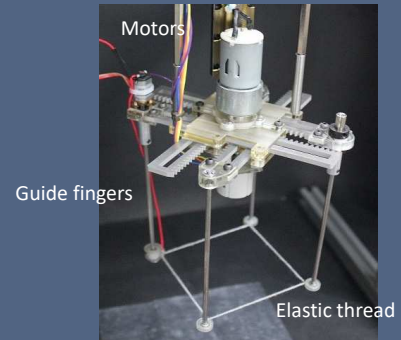
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Binding Hand



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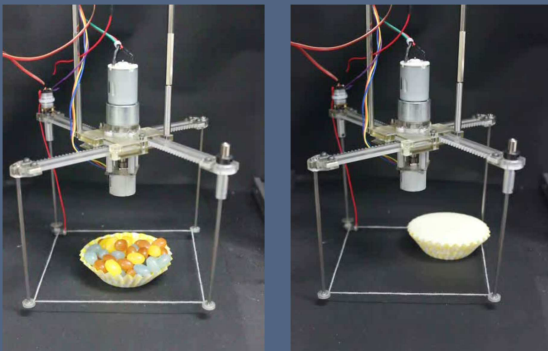
Binding Hand



Iwamasa and Hirai, IEEE ICRA, 2015

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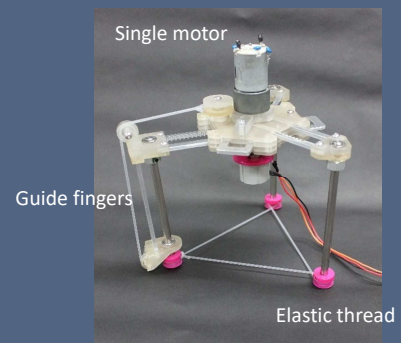
Binding Hand



Iwamasa and Hirai, IEEE ICRA, 2015

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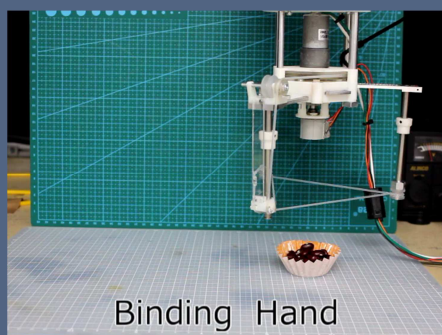
Binding Hand



Okada et al., IEEE RoboSoft 2019

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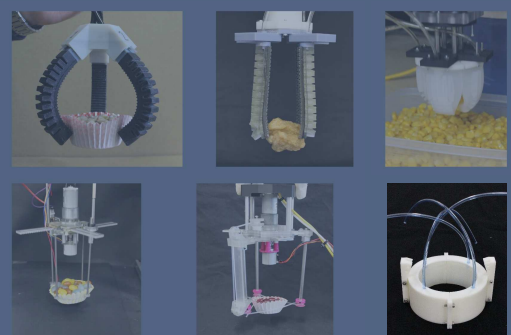
Binding Hand



Okada et al., IEEE RoboSoft 2019

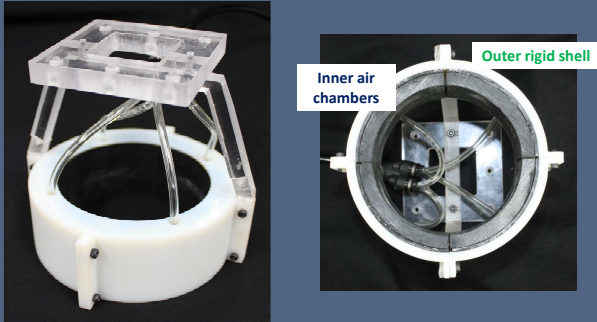
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Circular Shell Gripper



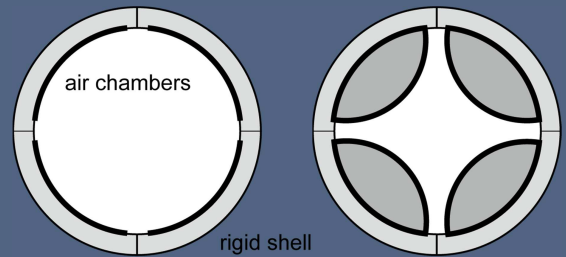
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Circular Shell Gripper



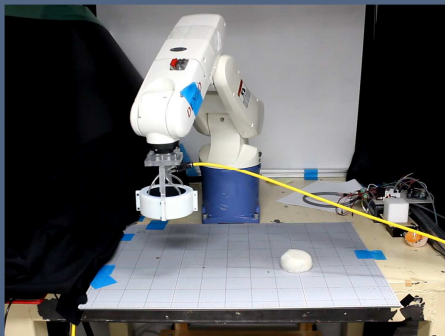
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Circular Shell Gripper



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Circular Shell Gripper



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Circular Shell Gripper



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SIP



Sensor-Rich Soft End-Effectors for Cyber-Physical Systems

Sadao Kawamura	Professor, Ritsumeikan Univ., / Vice President, Chitose Robotics
Hidemitsu Furukawa	Professor, Yamagata Univ. / Co-founder, D-lightmatter
Katsuya Kanaoka	President, Man-Machine Synergy Effectors, Inc.
Ryosuke Nishida	President, Chitose Robotics

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SIP

Developing robotic technology for food industry

food production, food preparation
and arrangement, cleaning up

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SIP Demonstration Room



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SIP Demonstration Room



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SIP Demonstration Room



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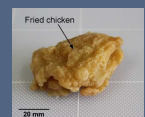
SIP Demonstration Room



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Toward Food Database

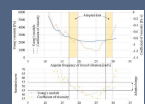
Shape / Textures



Mechanical Properties

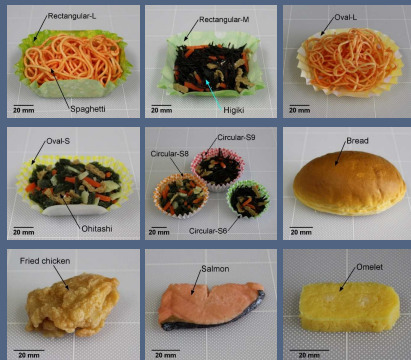
viscoelasticity

friction / adhesion



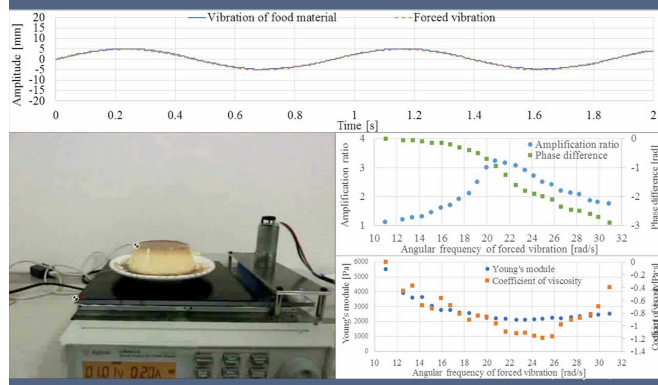
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Food Models



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Viscoelasticity Measurement



WS on Robotic Food Manipulation

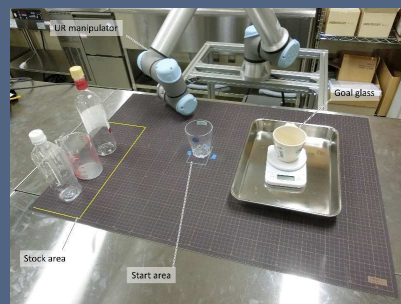


10/15, 2019
Toronto, Canada
IEEE Humanoids 2019

<https://sites.google.com/view/robotcook19/home>

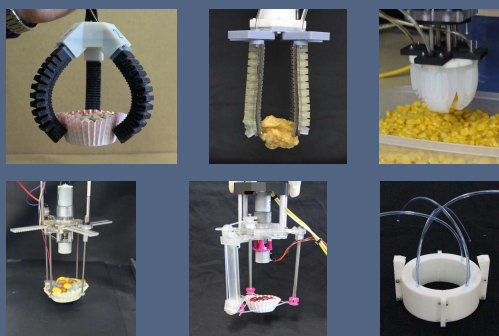
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Robotic Food Manipulation Challenge (under planning)



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Summary



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Q&A

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