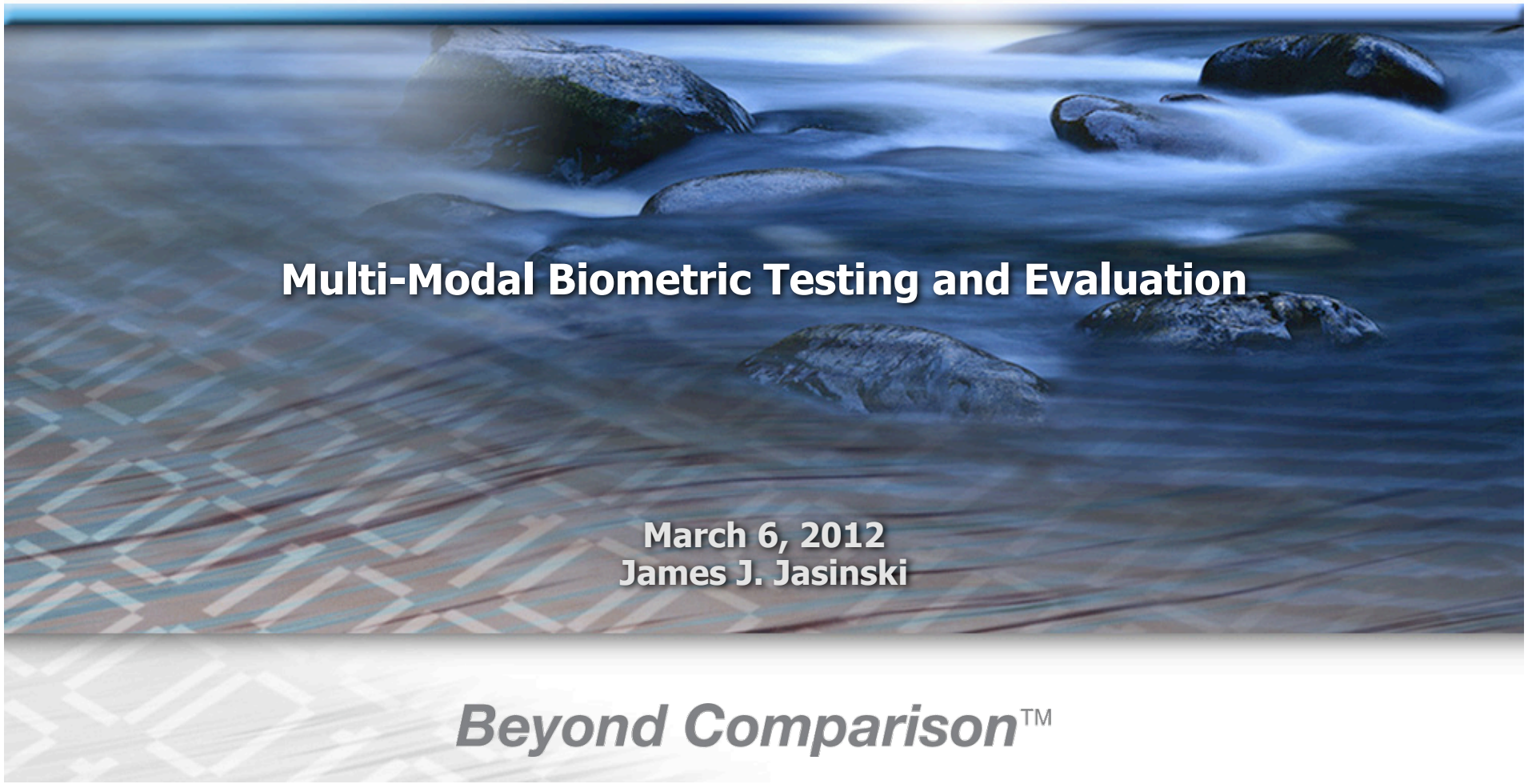
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Multi-Modal Biometric Testing and Evaluation

March 6, 2012

James J. Jasinski

Beyond Comparison™

Multi-Modal Testing and Evaluation

- ISO / NIST MBE / IDENT Pilot
- Thoughts and observations from our R&D work involving multi-modal system/device
- Testing workflow and evaluation criteria

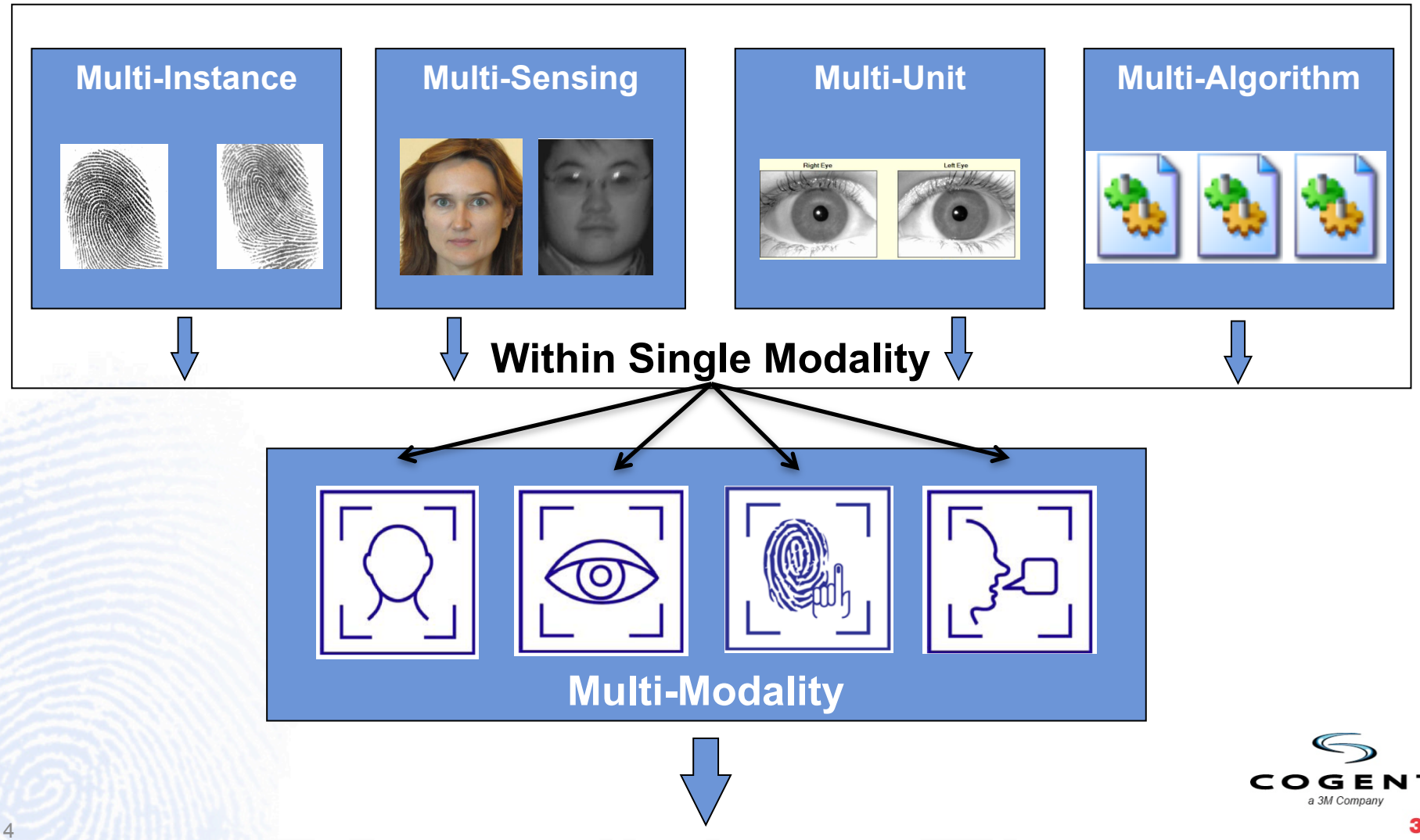
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Multiple Meanings of "Multi-Modal"

- Multi-Instance / Presentation
- Multi-Sensing
- Multi-Unit
- Multi-Algorithm
- Multi-Modality

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Multiple Meanings of "Multi-Modal"



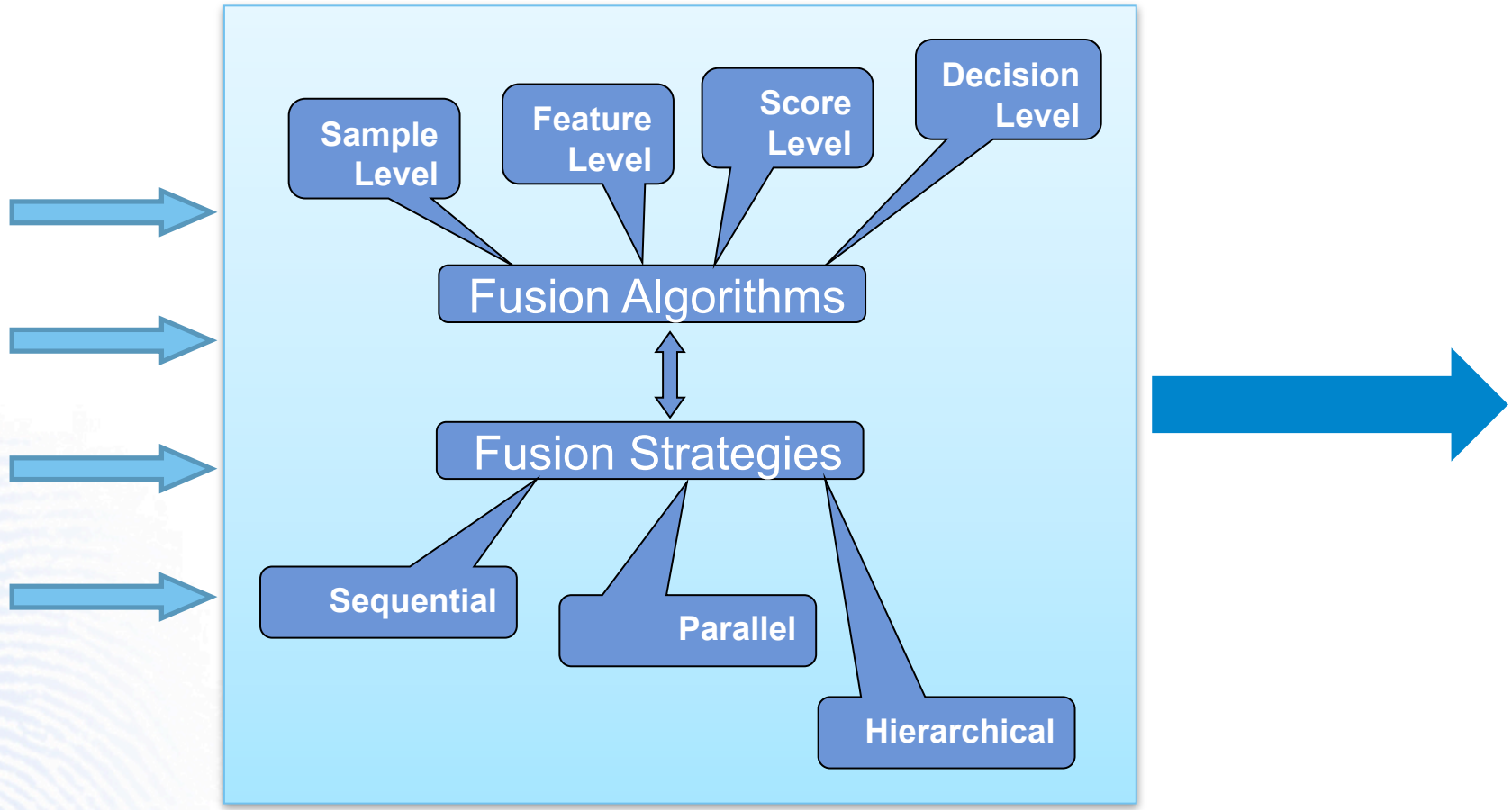
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Fusion Model

- Fusion Algorithm (method)
  - sample level
  - feature level
  - score level
  - decision level
- Fusion Strategy (operation mode)
  - sequential
  - parallel
  - hierarchical

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Fusion Model



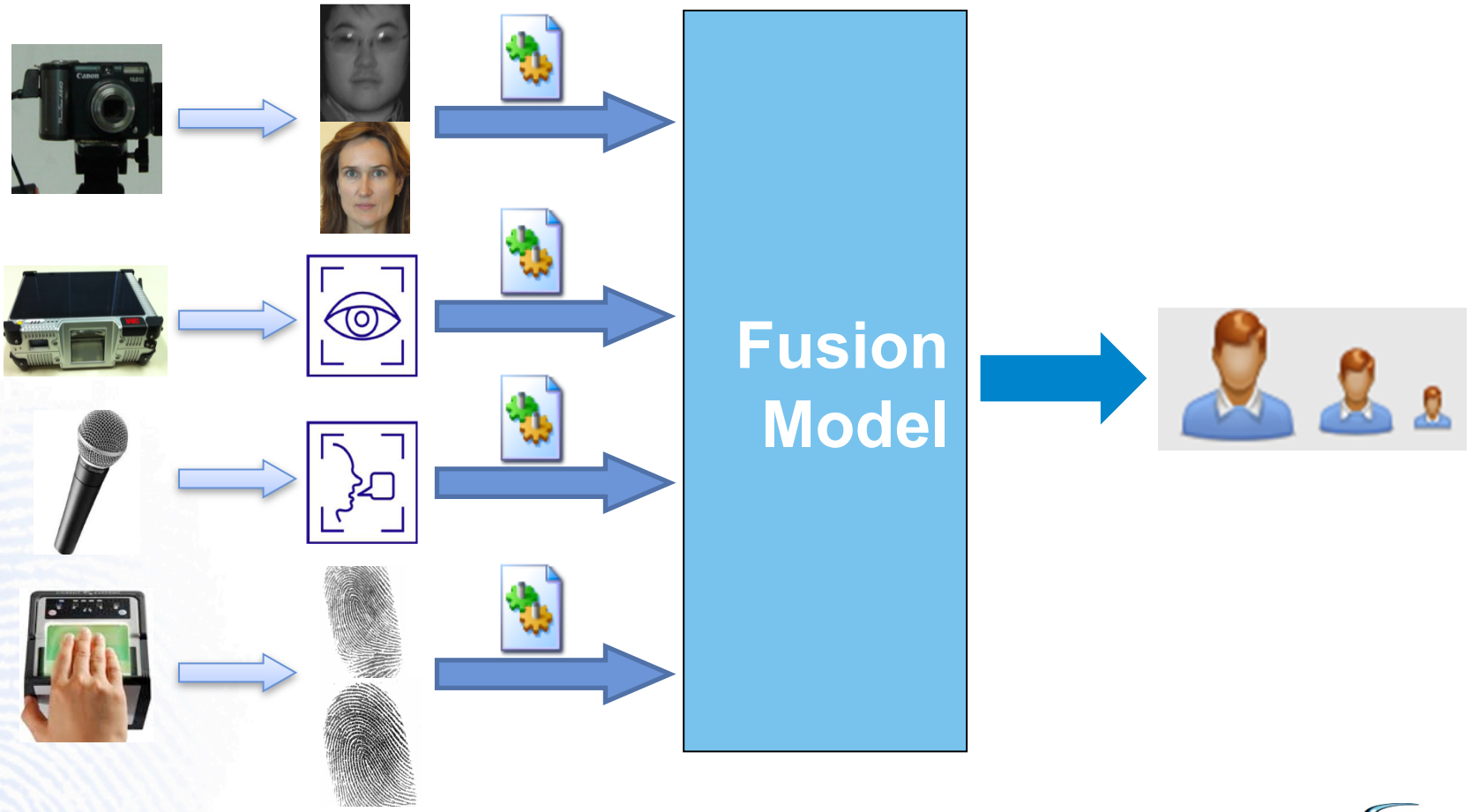
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Multi-Modal Capability

- Built on Top of Single-Modal Capability (Quality Evaluation/Feature Exaction/Matching)
- Multi-Modal Data Capture
- Fusion Model

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Multi-Modal Capability

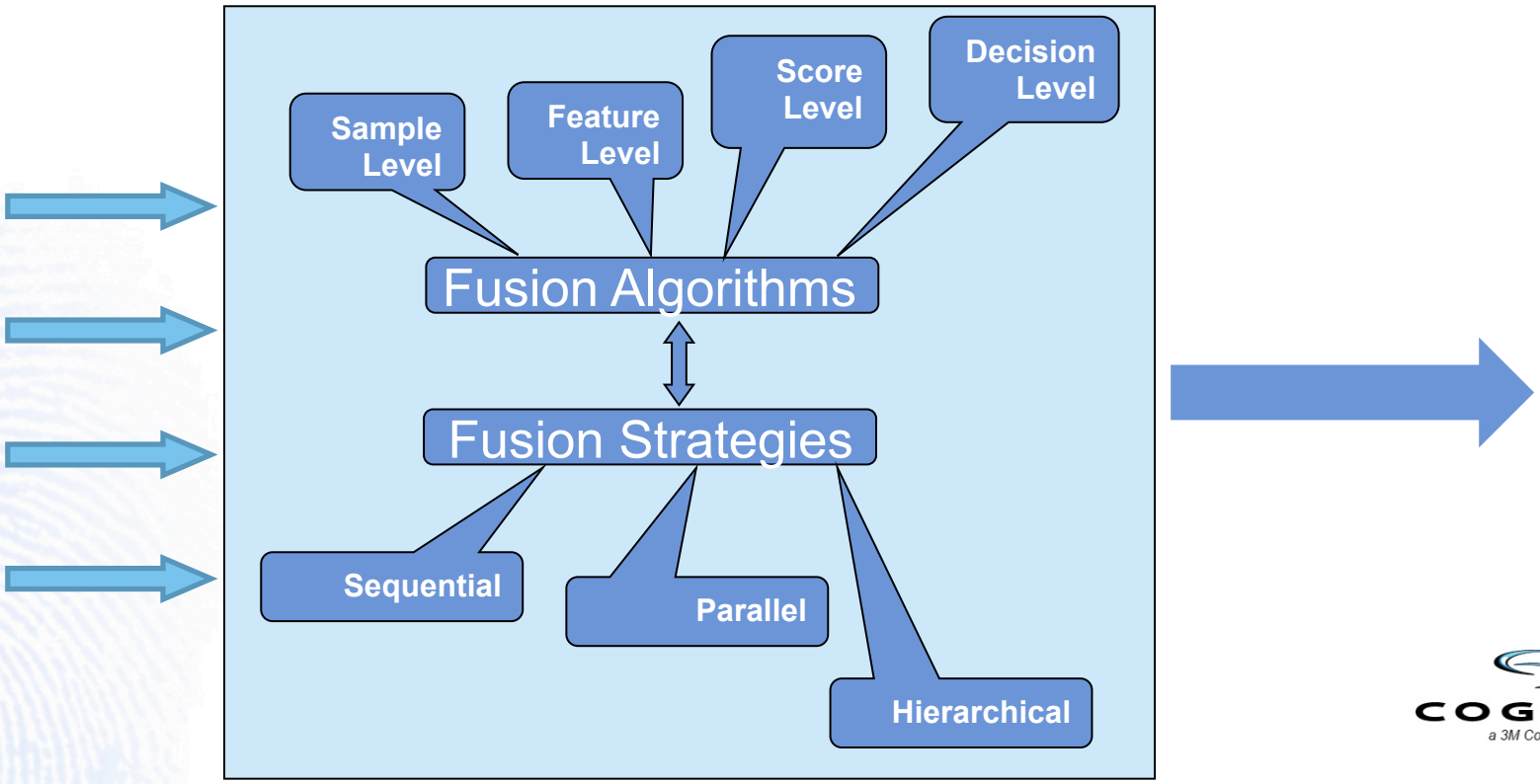


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Multi-Modal Testing

- Multimodal Data Capture Testing
- Fusion Model Testing



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Multi-Modal Testing

- Evaluate Performance
- Validate Multimodal Advantage
- Obtain Reference for R&D – selection of single-modal capability and fusion model
- Focus on Cases Involving Multiple Modalities

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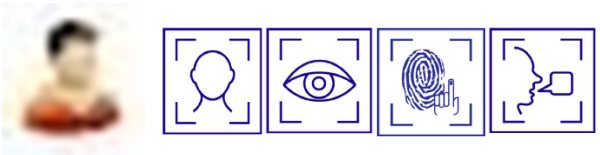
Goal

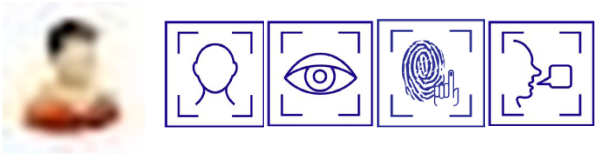
- Multi-Modal Capability Is Used in Biometrics Systems / Products to Improve:
  - accuracy
  - response time
  - availability
  - usability
    - Not addressed for this report
      a) data integrity
      b) system interoperability

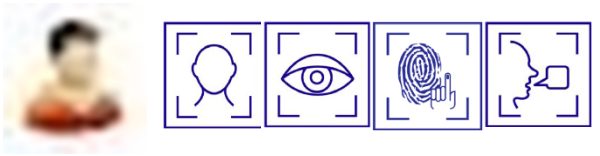
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Multiple Test Cases

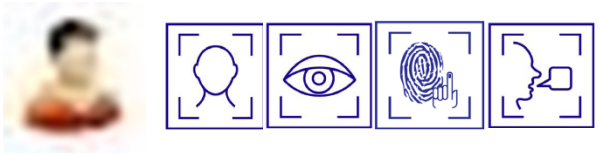
Ideally…

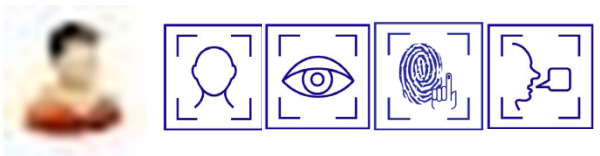












Probe

Gallery

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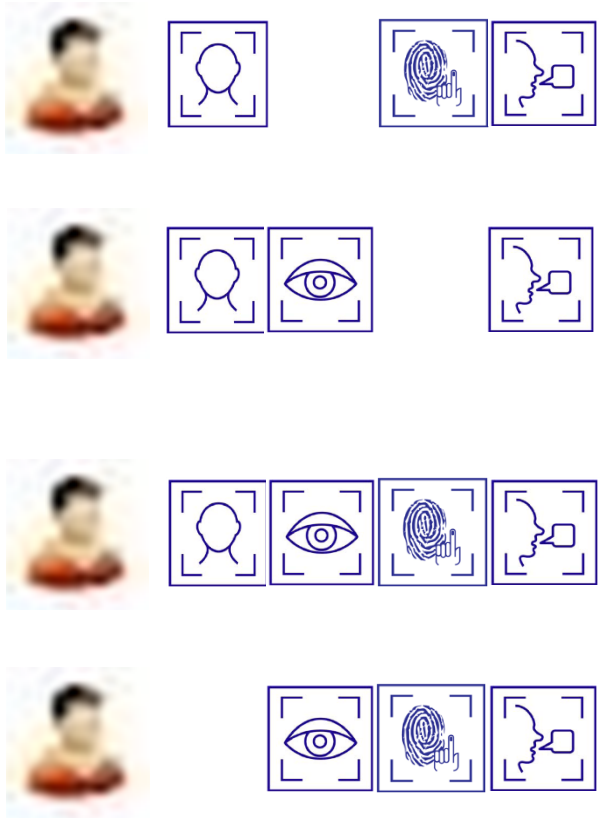
Multiple Test Cases

Real World…





Probe



Gallery

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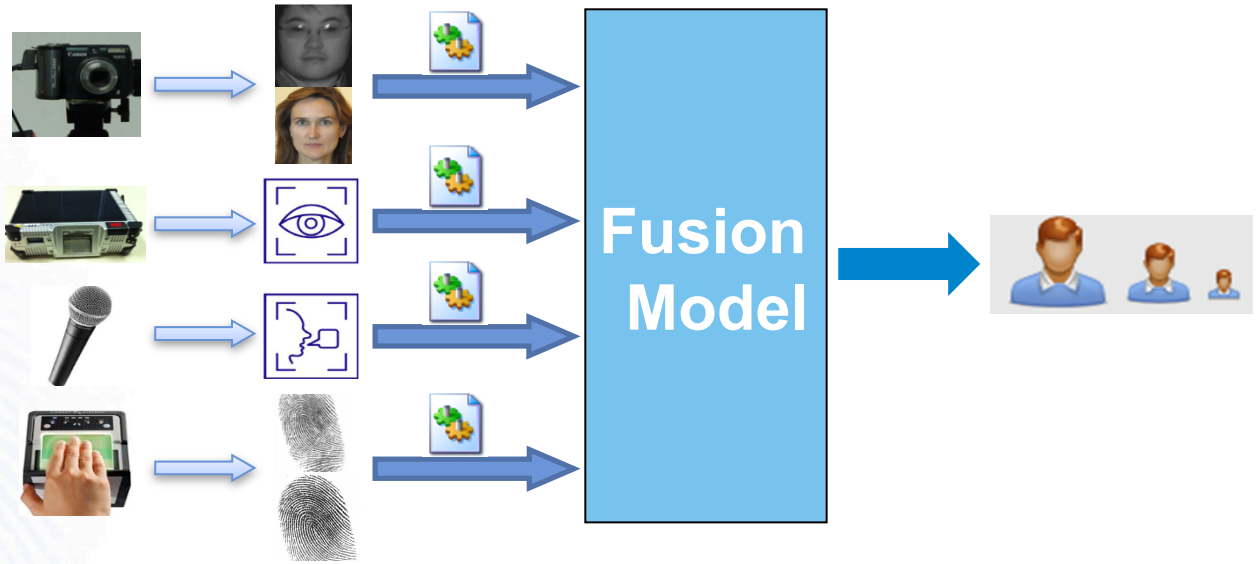
Performance Evaluation

- Accuracy
- Response Time
- Fusion Gain – with single modality performance as baseline

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Fusion Model Testing

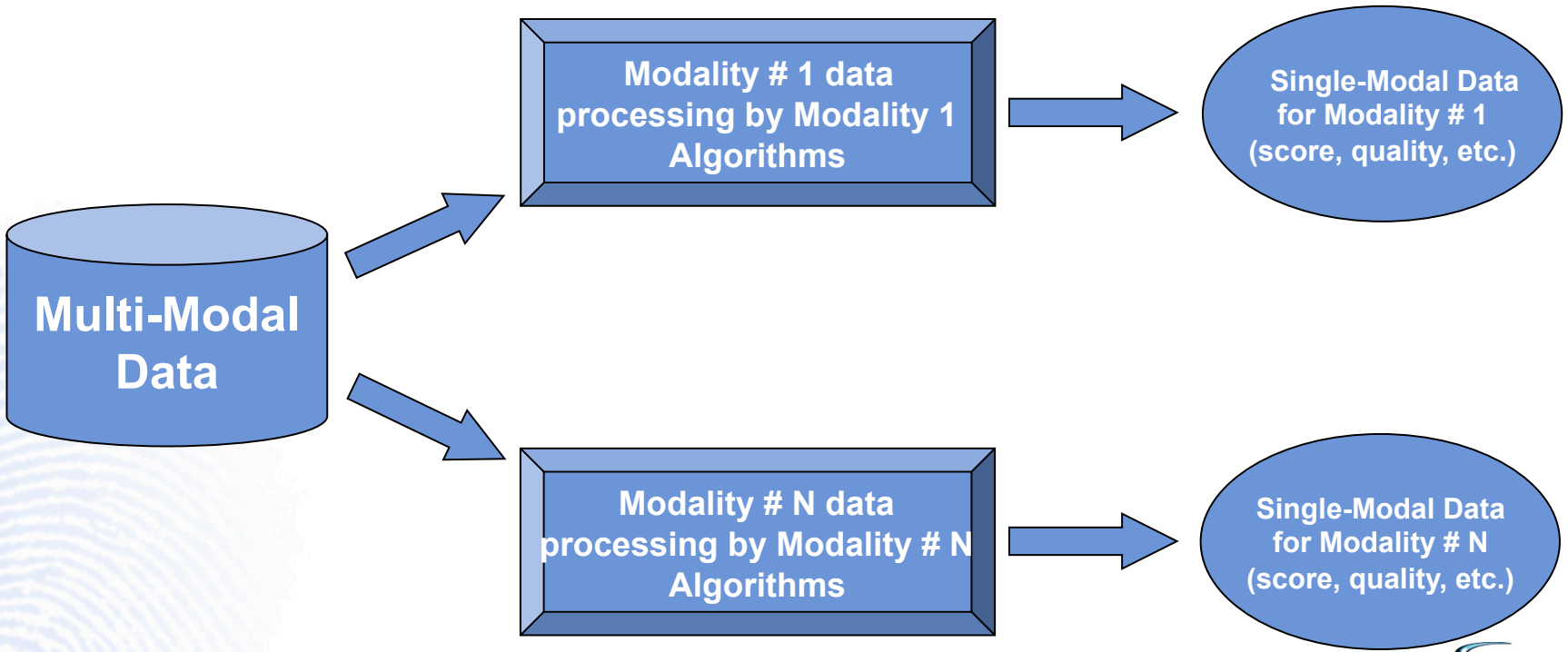
- With given single modality capabilities and testing database, evaluate the performance of the fusion model



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Fusion Model Testing

- Data Preparation for Training and Testing

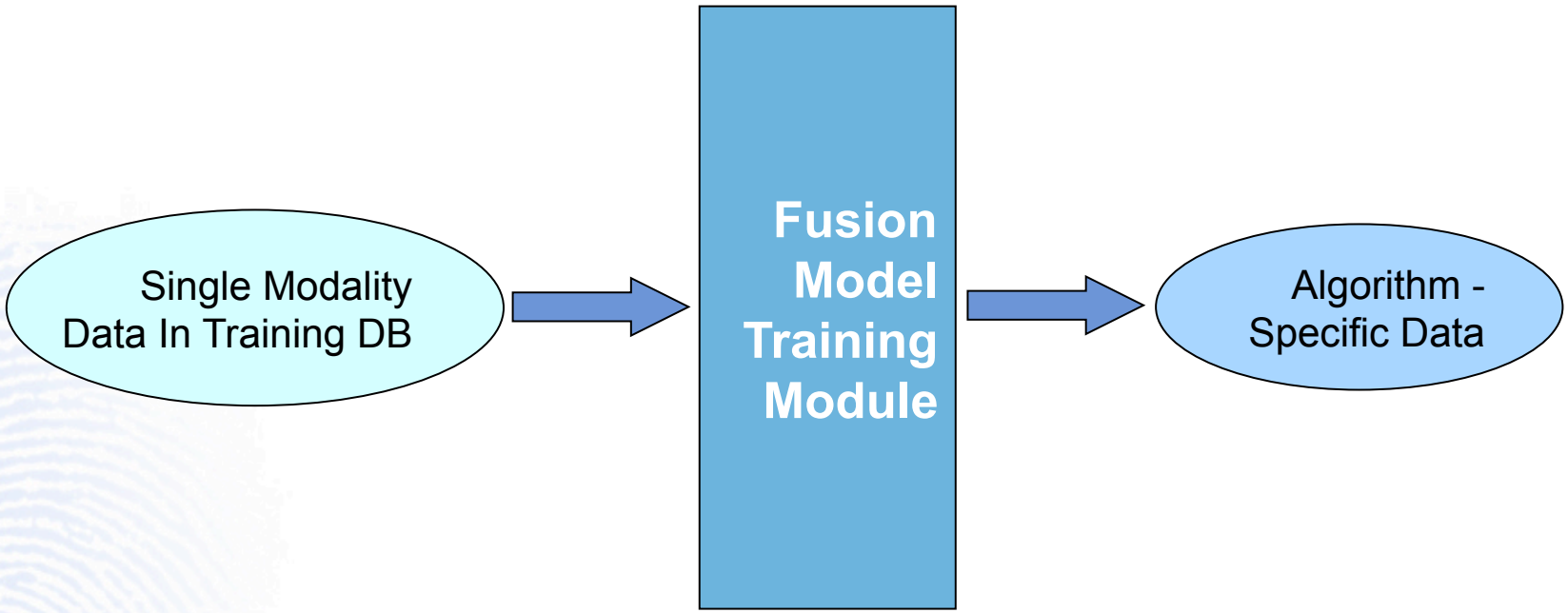


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Fusion Model Testing

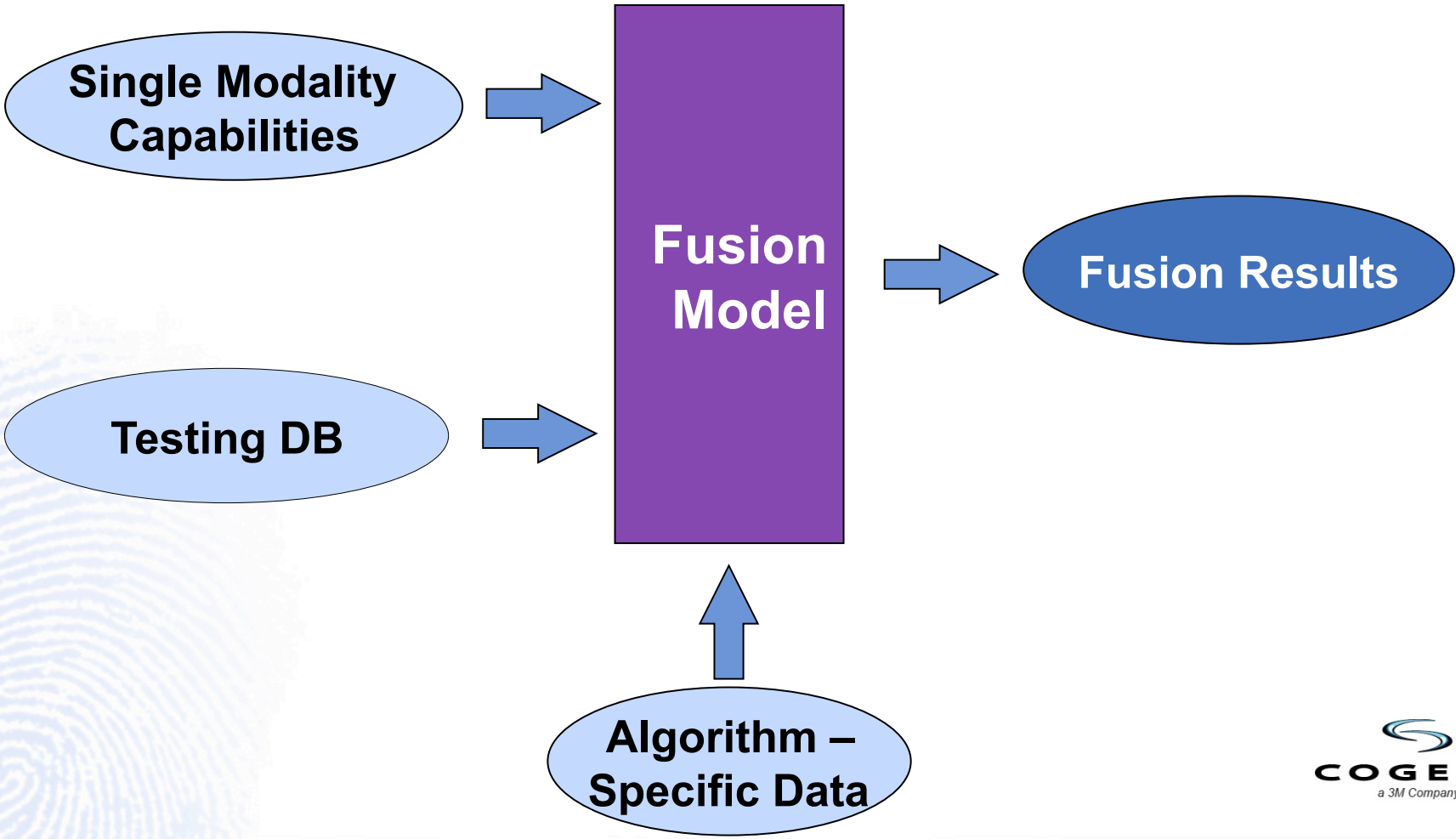
- Training (optional)



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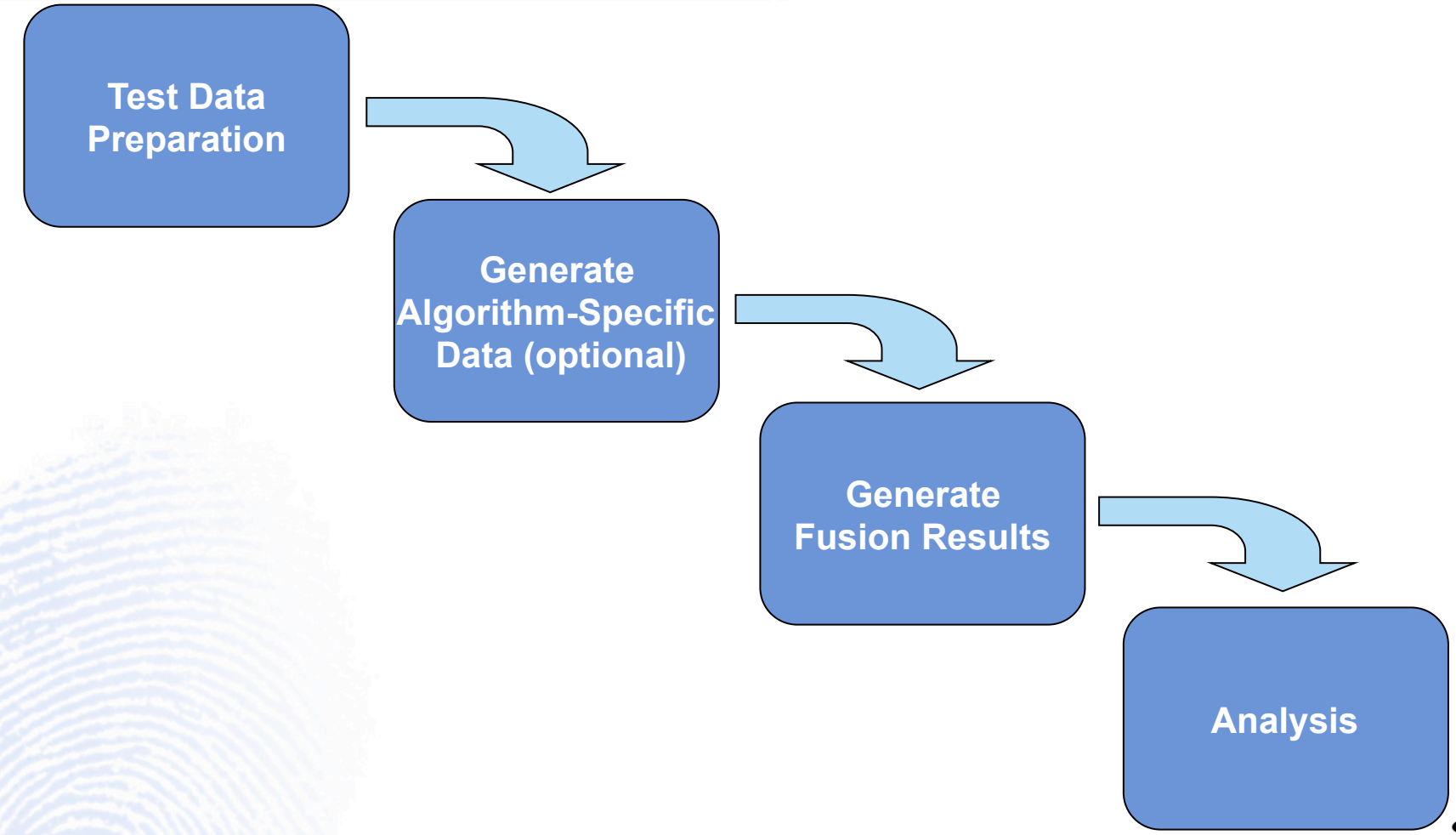
Fusion Model Testing

- Define Interface with Fusion Model



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Fusion Model Testing



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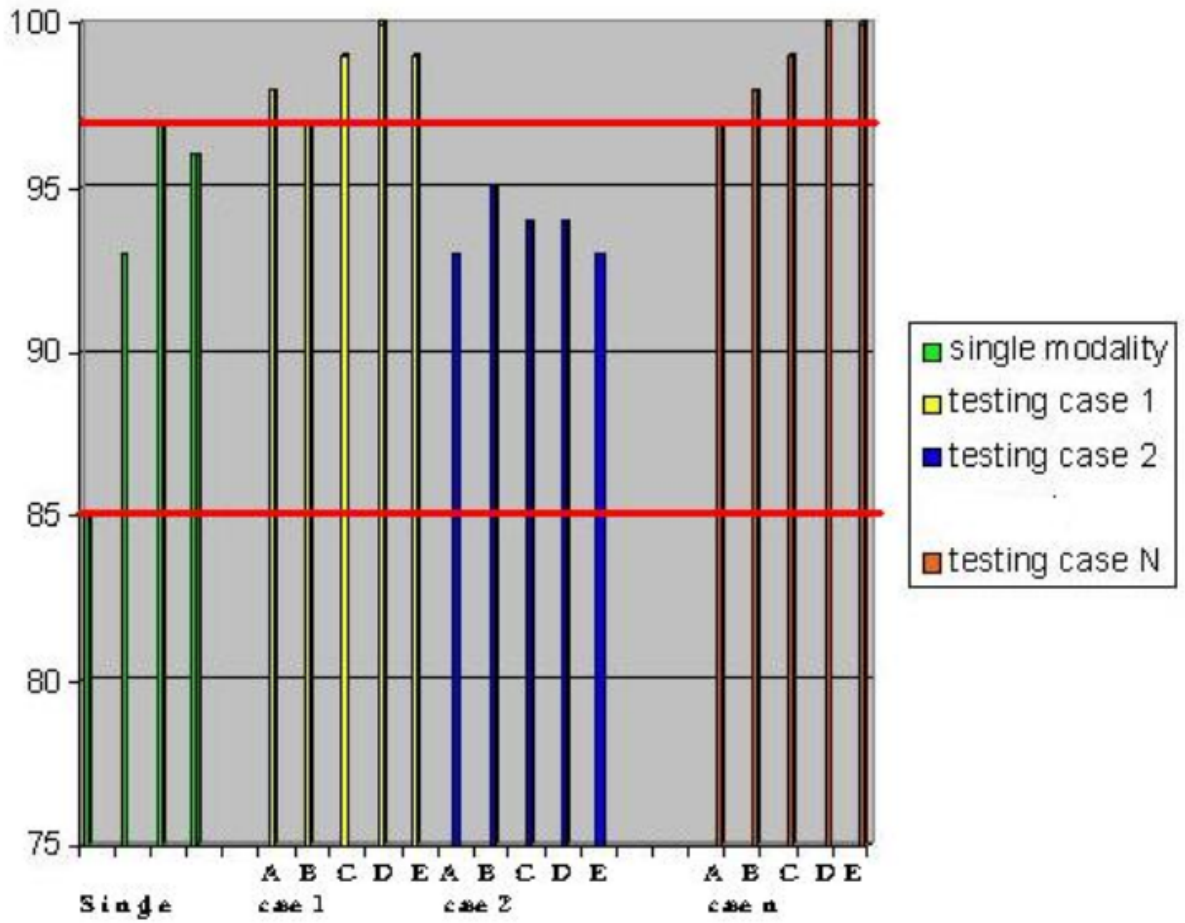
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Fusion Model Testing

	Fusion Model A	*Fusion Model B*	*Fusion Model C*	*Fusion Model D*	*Fusion Model E*
Testing case 1	1.25	2.2	1.43	1.56	2.0
Testing case 2	1.38	2.2	1.39	1.37	2.1
Testing case N	0.99	2.0	1.21	1.79	2.0

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Fusion Model Testing



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Multi-Modal Data Collection

- Design a collection protocol to cover
  - Collect at different times
  - Collect in different environments
  - Collect with different devices
  - Controls for data integrity

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Multi-Modal Data Collection

- Database Attribute – representative to target?
  - Number of subjects
  - Quality distribution
  - Distribution of age, gender and ethnic group

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Observations

- For multi-modal testing, both fusion model and “black box” are of interest.
- Fusion model testing is useful in studying/ evaluating fusion model and in building a modularized, multi-modal solution.
- “Black box” testing allows both single modality capability and fusion model to be customized for each other to maximize the gain.

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Observations cont.

- Since the fusion model performed best when the characteristics of single modality capability involved were taken into consideration, fusion model testing should support the option to let the fusion model ‘learn’ about single modality capability

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Observations cont.

- Multi-modal data collection is critical to the testing.
- Test cases can be chosen by application scenarios.

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