INN: Inflated Neural Networks for IPMN Diagnosis

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Problem: Intraductal Papillary Mucinous Neoplasm (IPMN) Diagnosis

Pancreatic Cancer Statistics

❑ **9%** 5-year survival rate; **10%** of patients diagnosed early.
❑ **Occurrence** & **mortality increased** from 2006 to 2017.
❑ Early diagnosis survival rate increased to 34% in 2019.
❑ Large proportion of IPMN ➜ invasive carcinoma.

Multisequence MRI

❑ Preferred modality for IPMN diagnosis (figure at right).
❑ Surgical pathology: normal pancreas, low-grade IPMN, high-grade IPMN/invasive carcinoma.
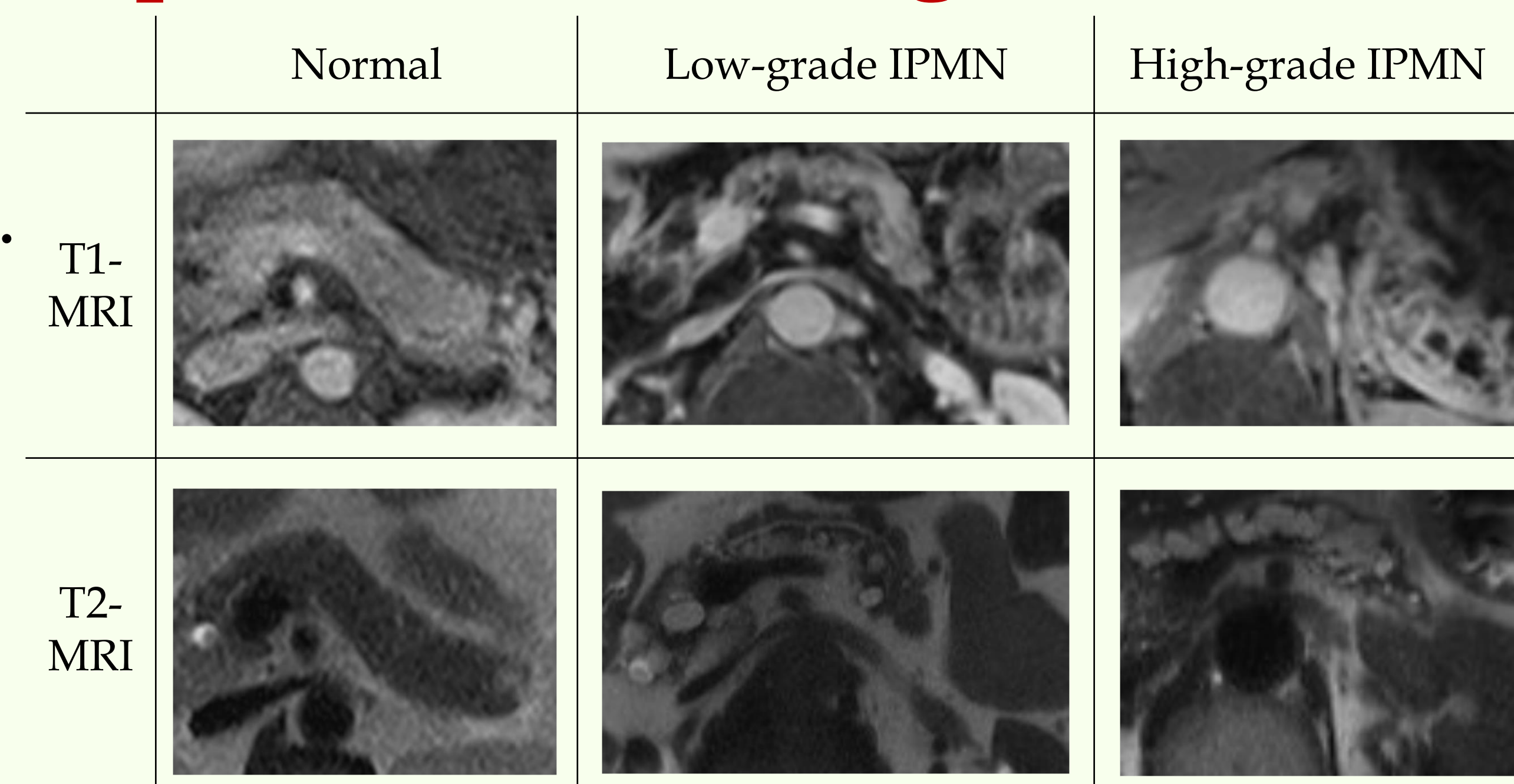
Unique Challenges for IPMN Diagnosis from Multisequence MRI

❑ Limited Data (139 MRI scans); Fusion strategies required; Previous studies focus on CT scans.
❑ Pre-operative diagnosis difficult with radiographic criteria & international consensus guidelines.

Proposed Method: Inflated Neural Networks for IPMN Diagnosis

Input:
❑ Whole-MRI or extracted pancreas-ROI.

Fusion Strategy:
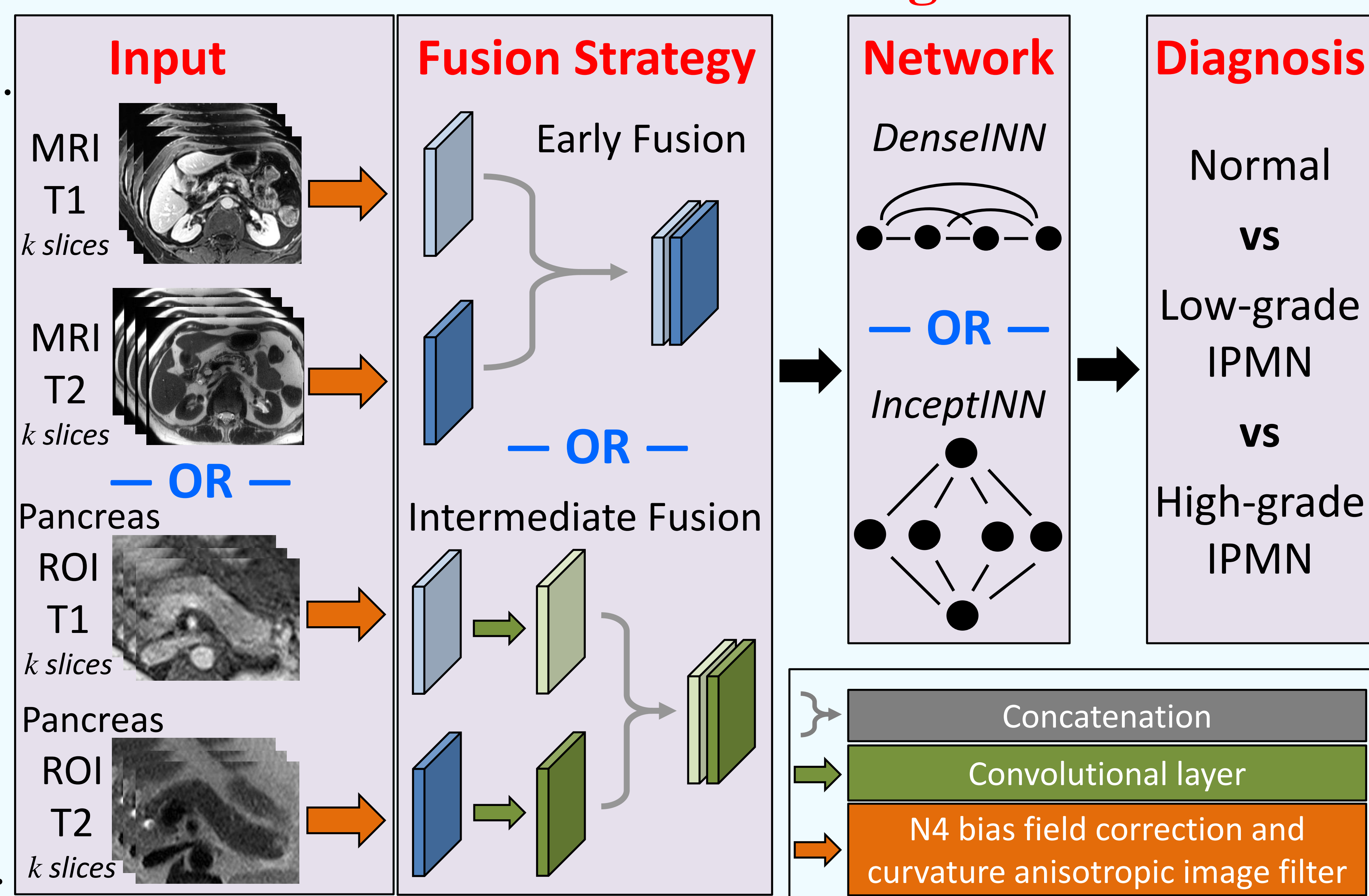❑ T1- & T2-MRI combined via early or intermediate fusion.

Network:
❑ Inflated DenseNet121 (*DenseINN*) or inflated Inceptionv3 (*InceptINN*).

Inflation Process:
❑ 2D kernels ➜ 3D, duplicate weights along channels & modalities, divide weights by number of duplications.

Diagnosis (Output):
❑ Normal, low-grade, high-grade IPMN.

Experiments & Results:

IPMN Diagnosis
❑ Top-left: **14%** improvement over [8].

Ablation Studies
❑ Bottom-left: Fusion methods.
❑ Right: Number of MRI slices input.

Method	Pre (SEM)%	Rec (SEM)%	Acc (SEM)%
Hussein et al. [8]	-	-	64.67 (0.83)
Baseline *InceptINN* Whole-MRI	61.59 (5.83)	58.18 (4.05)	61.87 (2.83)
InceptINN Whole-MRI	74.51 (4.70)	**71.24** (4.39)	73.38 (3.52)
Baseline *InceptINN* Pancreas-ROI	68.49 (2.63)	69.18 (3.40)	69.37 (3.11)
InceptINN Pancreas-ROI	71.68 (2.25)	70.11 (1.33)	72.32 (0.97)
Baseline *DenseINN* Pancreas-ROI	66.81 (4.51)	67.05 (3.06)	67.16 (2.93)
DenseINN Pancreas-ROI	**78.20** (4.17)	69.09 (2.97)	**73.43** (2.26)

Method	Early Fusion Pre %	Rec %	Acc %	Intermediate Fusion Pre %	Rec %	Acc %
InceptINN Whole-MRI	69.44	66.35	73.33	66.67	59.68	66.67
InceptINN Pancreas-ROI	79.29	**80.48**	78.57	70.77	69.66	75.00
DenseINN Pancreas-ROI	73.08	73.08	75.00	**88.10**	75.21	**82.14**

k slices	Whole-MRI Pre%	Rec%	Acc%	Pancreas-ROI Pre%	Rec%	Acc%
k = 3	57.22	56.83	60.00	82.83	**83.76**	**85.71**
k = 5	**66.67**	**59.68**	**66.67**	70.77	69.66	75.00
k = 7	-	-	-	**85.45**	81.91	82.14

Project Page & Code

https://qrgo.page.link/FJLSH