

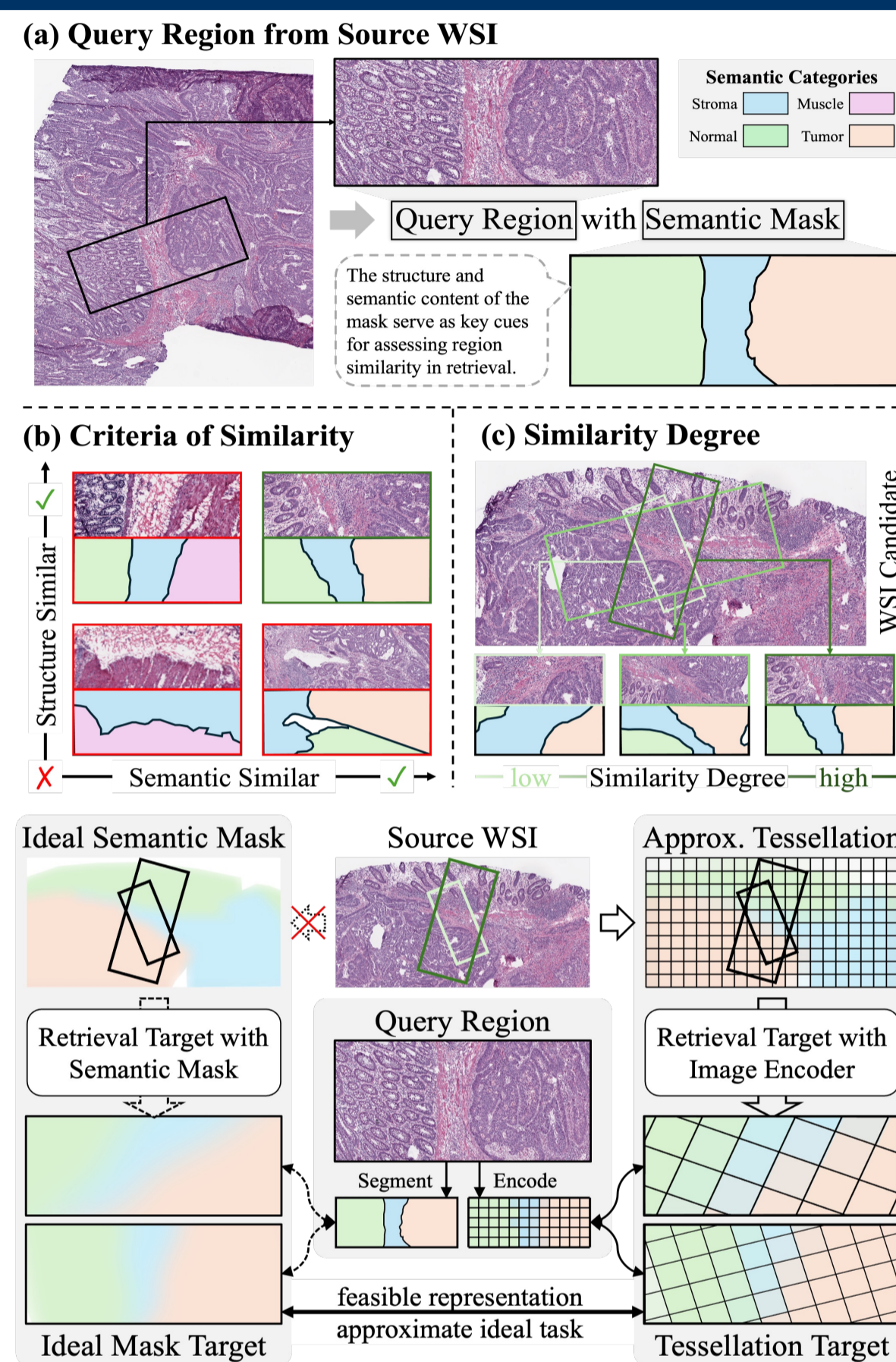


Main Page



Our Lab

Introduction



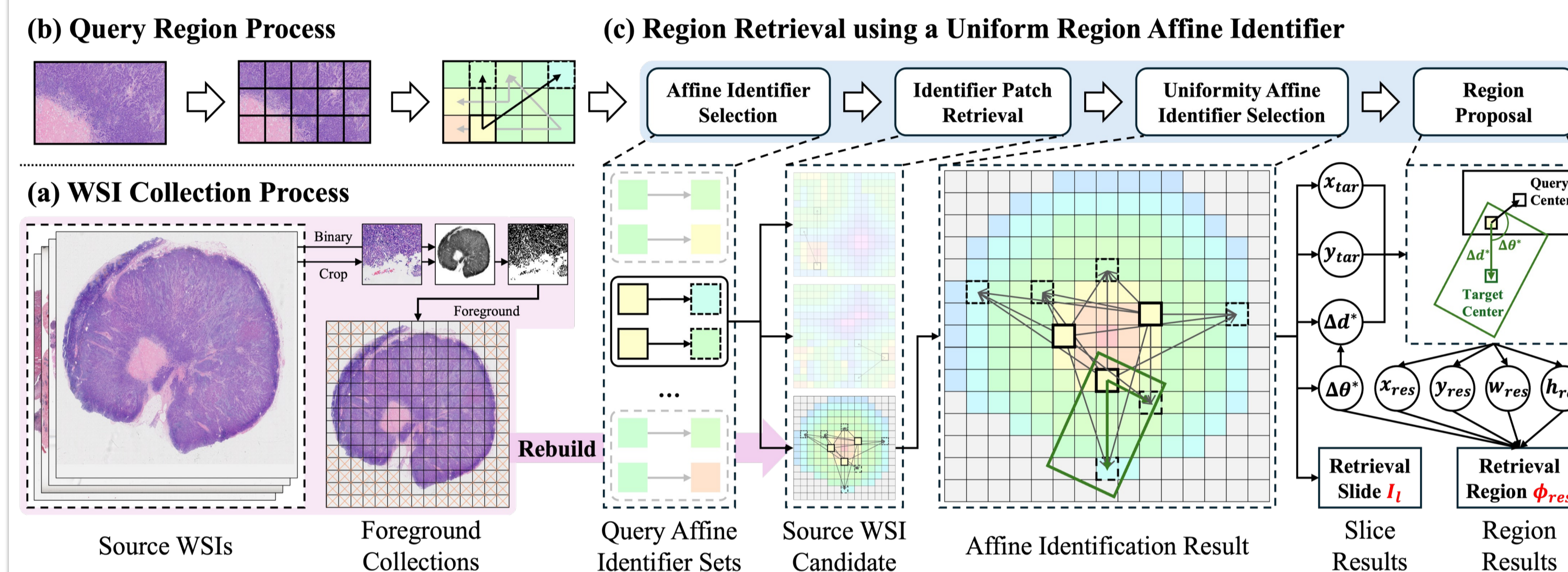
Whole slide image (WSI) region retrieval remains challenging due to the gigapixel scale of WSIs and the need to identify regions with similar semantic distributions under arbitrary transformations.

- Existing methods fail on region task.
 - Suffer from spatial-semantic decoupling.
- To enable pixel-level region matching, we formally define the task and its approximation and propose the URICA.

- Firstly, Semantic tessellation structures for effective approximation representation.
- Secondly, Affine-based identifier enables rotation- and scale-invariant matching.
- Thirdly, A theoretical analysis proves that adaptive tessellation approximates pixel-level mask retrieval.

Approach

URICA retrieves arbitrary WSI regions by combining semantic tessellation with uniform affine identifier matching, and locating arbitrary region with $\phi = (x, y, w, h, \theta)$.



- First, it indexes foreground WSI patches with spatial information for efficient retrieval.
- Then, it matches patches based on target identifiers to identify uniform shift groups.
- Finally, URICA reconstructs the matched region for robust region-level retrieval.

Experiments

The experiments evaluate URICA's accuracy, robustness, and efficiency across diverse WSI retrieval tasks on TCGA** data with Qdrant***. (See the paper and appendix for full results.)

24.811 WSIs, 13.5 TB Data, 10 Sites, 29 Subtypes

WSI Site	Query	Slide Method		Sample Method		Adjacent Method		URICA (ours)		WSI Site	Query	Slide Method
		mSim@5	mIoU@5	mSim@5	mIoU@5	mSim@5	mIoU@5	mSim@5	mIoU@5			
Pul.	2763	0.6812	0.1656	0.8582	0.3163	0.1671	0.0262	0.9402	0.6416	Liv./PB.	886	0.657
LUAD	1320	0.6833	0.1673	0.8633	0.3187	0.1721	0.0287	0.9489	0.6302	CHOL	55	0.600
LUSC	1335	0.6846	0.1662	0.8536	0.3171	0.1647	0.0251	0.9346	0.6576	LIHC	520	0.663
MESO	108	0.6208	0.1432	0.8506	0.2763	0.1534	0.0177	0.8907	0.5422	PAAD	311	0.657
Uri.	3209	0.6929	0.1684	0.8602	0.3065	0.1564	0.0239	0.9306	0.6485	Gyn.	2562	0.675
BLCA	588	0.6325	0.1462	0.8424	0.2540	0.1332	0.0168	0.8402	0.5943	UCEC	811	0.657
KIRC	1805	0.7105	0.1748	0.8632	0.3200	0.1607	0.0254	0.9560	0.8706	CESC	358	0.594
KICH	265	0.7242	0.1815	0.8649	0.3172	0.1701	0.0287	0.9400	0.5571	UCS	95	0.661
KIRP	551	0.6846	0.1649	0.8671	0.3130	0.1607	0.0246	0.9617	0.6563	OV	1298	0.709
MeI.	645	0.6414	0.1472	0.8422	0.2556	0.1391	0.0168	0.7295	0.4862	Pro./Tes.	1126	0.651
UVM	97	0.6316	0.1393	0.8455	0.2227	0.1308	0.0127	0.9584	0.7000	TGCT	292	0.661
SKCM	548	0.6432	0.1486	0.8416	0.2614	0.1405	0.0176	0.7009	0.4594	PRAD	834	0.647
Bra.	2939	0.6919	0.1561	0.8727	0.2883	0.1551	0.0222	0.9223	0.6427	Hem.	286	0.684
GBM	1739	0.6786	0.1551	0.8649	0.2918	0.1528	0.0224	0.8863	0.6117	DLBC	77	0.667
LGG	1200	0.7112	0.1575	0.8841	0.2832	0.1585	0.0218	0.9678	0.6817	THYM	209	0.690
GL.	2690	0.6546	0.1655	0.8456	0.3087	0.1468	0.0245	0.8637	0.5953	End.	1163	0.667
COAD	1140	0.6642	0.1676	0.8475	0.3132	0.1458	0.0247	0.8573	0.5959	ACC	229	0.710
ESCA	215	0.6002	0.1388	0.8353	0.2666	0.1202	0.0169	0.5939	0.4923	PCPG	242	0.668
READ	389	0.6402	0.1601	0.8483	0.3041	0.1441	0.0243	0.9619	0.6160	THCA	692	0.650
STAD	946	0.6613	0.1712	0.8444	0.3147	0.1552	0.0260	0.8646	0.5959	-	-	-

Task Definition

Given a pathology image I and a semantic mask M , a region $r_\phi \in I$ or a semantic mask $m_\phi \in M$ can be described by a tuple $\phi = (x, y, w, h, \theta)$, which represent a rotatable and scalable target.

For the given query region r_{ϕ_q} with unknown I_q, x, y and θ , the region retrieval is to find a region $r_{\phi_{res}} \in \mathcal{J}$, such that:

$$\forall r_\phi \in \mathcal{J}, \text{Sim}(r_{\phi_q}, r_{\phi_{res}}) \geq \text{Sim}(r_{\phi_q}, r_\phi)$$

where \mathcal{J} is the target WSI sources.

Affine Identifier

The figure shows that with the brown shared starting point, each query affine (blue and purple solid arrows) can yield many affine identifiers (dashed arrows). While different combination can yield many region (grey box). The return subset (arrows in green box) exists with the most uniform on angle and scale shifting.

