

Types of Data		
Quantitative attributes	Qualitative attributes	Mixed attributes
<div><p>Type I: Uncommon number anomaly</p><div><div><p>a) Extreme tail value</p></div><div><p>b) Isolated intermediate value</p></div></div></div>	<div><p>Type II: Uncommon class anomaly</p><div><div><p>a) Unusual class</p></div><div><p>b) Deviant repeater</p></div></div></div>	<div><p>Type III: Simple mixed data anomaly</p><div><div><p>a) Extreme tail uncommon class</p></div><div><p>b) Intermediate uncommon class</p></div></div></div>
Atomic univariate anomaly		
<div><p>Type IV: Multidimensional numerical anomaly</p><div><div><p>a) Peripheral point</p></div><div><p>b) Enclosed point</p></div><div><p>c) Local density anomaly</p></div><div><p>d) Global density anomaly</p></div><div><p>e) Local additive anomaly</p></div><div><p>f) Deviant numerical spatial point (typically in images)</p></div><div><p>g) Deviant numerical spatio-temporal point (typically in videos)</p></div></div></div>	<div><p>Type V: Multidimensional categorical anomaly</p><div><div><p>a) Uncommon class combination</p></div><div><p>b) Deviant categorical vertex</p></div><div><p>c) Deviant categorical edge</p></div></div></div>	<div><p>Type VI: Multidimensional mixed data anomaly</p><div><div><p>a) Incongruous common class</p></div><div><p>b) Incongruous common sequential class</p></div><div><p>c) Deviant vertex</p></div><div><p>d) Unusual vertex, insertion/change/removal</p></div><div><p>e) Deviant edge</p></div><div><p>f) Unusual edge, insertion/change/removal</p></div><div><p>g) Deviant spatial point (typically in geo data)</p></div><div><p>h) Deviant spatio-temporal point (typically in geo data)</p></div></div></div>
Atomic multivariate anomaly		
<div><p>Type VII: Aggregate numerical anomaly</p><div><div><p>a) Deviant cycle</p></div><div><p>b) Temporary change</p></div><div><p>c) Level shift</p></div><div><p>d) Irrational outlier</p></div><div><p>e) Trend change</p></div><div><p>f) Variation change</p></div><div><p>g) Deviant numerical spatial region (typically in images)</p></div><div><p>h) Deviant numerical spatio-temporal region (typically in videos)</p></div><div><p>i) Point-based aggregate anomaly</p></div><div><p>j) Distribution-based aggregate anomaly</p></div></div></div>	<div><p>Type VIII: Aggregate categorical anomaly</p><div><div><p>a) Deviant class aggregate (typically in texts)</p></div><div><p>b) Deviant categorical subgraph</p></div><div><p>c) Deviant relational aggregate</p></div></div></div>	<div><p>Type IX: Aggregate mixed data anomaly</p><div><div><p>a) Class change</p></div><div><p>b) Deviant class cycle</p></div><div><p>c) Deviant class sequence</p></div><div><p>d) Deviant isolation/shift/shape/amplitude/trend/deviation sequence</p></div><div><p>e) Deviant subgraph</p></div><div><p>f) Aggregating/disappearing/flickering/merging/splitting/growing/shrinking/eccentric (subgraph)</p></div><div><p>g) Deviant spatial region (typically in geo data)</p></div><div><p>h) Deviant spatio-temporal region (typically in geo data)</p></div><div><p>i) Point-based mixed data aggregate anomaly</p></div><div><p>j) Distribution-based mixed data aggregate anomaly</p></div></div></div>
Aggregate anomaly		
Anomaly Level		

Legend	
	Normal point or object
	Anomalous point or object
	Independent data
	Dependent data

Fig. 3: The typology including all types and subtypes. Each anomaly subtype is represented by an icon that depicts the essence of the deviation. An icon that includes lines represents a set with dependent data. (Zoom in on a digital screen to see details.)