

## Supplementary Information

**Table S1.** The relative position-specific propensities of each amino acid at each position.

<b>A</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>	<b>G</b>	<b>H</b>
1.0608	0.6400	0.9923	0.9987	0.8570	1.0526	1.2277
<b>I</b>	<b>K</b>	<b>L</b>	<b>M</b>	<b>N</b>	<b>P</b>	<b>Q</b>
1.0897	1.2497	0.9639	0.9355	1.1295	0.9997	0.9530
<b>R</b>	<b>S</b>	<b>T</b>	<b>V</b>	<b>W</b>	<b>Y</b>	
1.1203	0.9166	1.0205	1.0007	0.7402	0.9247	

**Table S2.** Jackknife results for different weight parameters using BPB + Ecomposition + Scomposition.

<i>WI</i>	<i>Sn (%)</i>	<i>Sp (%)</i>	<i>Acc (%)</i>	<i>MCC</i>
1	22.19	92.60	69.13	0.2121
1.5	50.51	77.30	68.37	0.2811
<b>2</b>	<b>65.31</b>	<b>65.63</b>	<b>65.52</b>	<b>0.2933</b>
2.5	74.23	54.91	61.35	0.2761

**Table S3.** Jackknife results for different weight parameters using BRABSB + Ecomposition + Scomposition.

<i>WI</i>	<i>Sn (%)</i>	<i>Sp (%)</i>	<i>Acc (%)</i>	<i>MCC</i>
1	30.36	88.58	69.18	0.2338
1.5	52.42	74.36	67.05	0.2655
2	67.09	63.97	65.01	0.2936
<b>2.5</b>	<b>73.09</b>	<b>58.16</b>	<b>63.14</b>	<b>0.2949</b>
3	77.55	52.17	60.63	0.2836

**Table S4.** Jackknife results for different weight parameters using ANBPB + Ecomposition + Scomposition.

<i>WI</i>	<i>Sn (%)</i>	<i>Sp (%)</i>	<i>Acc (%)</i>	<i>MCC</i>
1	30.87	88.33	69.18	0.2352
1.5	51.91	74.17	66.75	0.2586
<b>2</b>	<b>67.60</b>	<b>64.29</b>	<b>65.39</b>	<b>0.3014</b>
2.5	73.47	58.42	63.44	0.3009

**Table S5.** Jackknife results for different weight parameters using RANS + Ecomposition + Scomposition.

<i>WI</i>	<i>Sn (%)</i>	<i>Sp (%)</i>	<i>Acc (%)</i>	<i>MCC</i>
1	34.82	85.52	68.62	0.2344
1.5	48.9	73.28	64.88	0.2128
2	58.55	66.45	63.82	0.2389
<b>2.5</b>	<b>63.90</b>	<b>61.42</b>	<b>62.24</b>	<b>0.2391</b>
3	65.82	56.57	59.65	0.2111