# 1 APPENDIX

**Table 1: Classical Symbolic Regression Benchmarks(SRB).**

| FileNumber | FileName | Objective Function | Data Set |
|---|---|---|---|
| F1 | Keijzer-5 | $log(x)$ | U[0,2,20] |
| F2 | Nguyen-8 | $sqrt(x)$ | U[0,2,20] |
| F3 | Korns-1 | $1.57 + 24.3x$ | U[-1,1,20] |
| F4 | Korns-6 | $6.87 + 11cos(7.23x^3)$ | U[-0.5,0.5,20] |
| F5 | Nguyen-4 | $x^6 + x^5 + x^4 + x^3 + x^2 + x$ | U[-1,1,20] |
| F6 | Nguyen-3 | $x^5 + x^4 + x^3 + x^2 + x$ | U[-1,1,20] |
| F7 | Koza-1,Nguyen-2 | $x^4 + x^3 + x^2 + x$ | U[-1,1,20] |
| F8 | Nguyen-1 | $x^3 + x^2 + x$ | U[-1,1,20] |
| F9 | Koza-3 | $x^6 - 2x^4 + x^2$ | U[-1,1,20] |
| F10 | Koza-2 | $x^5 - 2x^3 + x$ | U[-1,1,20] |
| F11 | Nguyen-5 | $cos(x)sin(x^2) - 1$ | U[-1.6,1.6,20] |
| F12 | Nguyen-6 | $sin(x) + sin(x + x^2)$ | U[-1,1,20] |
| F13 | Nguyen-11 | $x^y$ | U[2,4,400] |
| F14 | Keijzer-11 | $xy + sin((x - 1)(y - 1))$ | U[-1,1,400] |
| F15 | Nguyen-12 | $x^4 - x^3 + y^2/2 - y$ | U[-1,1,400] |
| F16 | Keijzer-13 | $6sin(x)cos(y)$ | U[-1,1,400] |
| F17 | Keijzer-15 | $x^3/5 + y^3/2 - y - x$ | U[-1,1,400] |
| F18 | Nguyen-9 | $sin(x) + sin(y^2)$ | U[-1,1,400] |
| F19 | Nguyen-10 | $2sin(x)cos(y)$ | U[-1,1,400] |
| F20 | Vladislavleva-1 | $exp(-(x - 1))^2/(1.2 + (y - 2.5)^2)$ | U[-1,1,400] |
| F21 | Keijzer-3 | $30xz/((x - 10)y^y)$ | x,z:[-1,1,1000] y:U[1,3,1000] |
| F22 | Korns-2 | $0.23 + 14.2(x + y)/(3z)$ | x,y:U[-1,1,1000] z:U[1,3,1000] |
| F23 | Vladislavleva-5 | $30((x - 1)(z - 1))/(y^2(x - 10))$ | U[0,2,1000] |

**Table 2: Feynman Symbolic Regression Benchmarks(FSRB).**

| FileNumber | FileName | Output | Objective Function | Data Set |
|---|---|---|---|---|
| F24 | I.6.2a | $f$ | $exp(-\theta^2/2)/sqrt(2\pi)$ | U[1,3,20] |
| F25 | I.6.2 | $f$ | $exp(-(\theta/\sigma)^2/2)/(sqrt(2\pi)\sigma)$ | U[1,3,400] |
| F26 | I.12.1 | $F$ | $muN_n$ | U[2,4,400] |
| F27 | I.12.5 | $F$ | $q_2Ef$ | U[2,4,400] |
| F28 | I.14.4 | $U$ | $1/2k_{spring}x^2$ | U[2,4,400] |
| F29 | I.25.13 | $Volt$ | $q/C$ | U[2,4,400] |
| F30 | I.26.2 | $\theta_1$ | $arcsin(nsin(\theta_2))$ | $n$:U[0,1,400] $\theta_2$:U[2,4,400] |
| F31 | I.29.4 | $k$ | $\omega/c$ | U[2,4,400] |
| F32 | I.34.27 | $E_n$ | $(h/(2\pi))\omega$ | U[2,4,400] |
| F33 | I.39.1 | $E_n$ | $3/2prV$ | U[2,4,400] |
| F34 | II.3.24 | $flux$ | $Pwr/(4\pi r^2)$ | U[2,4,400] |
| F35 | II.8.31 | $E_{den}$ | $\epsilon\ Ef^2/2$ | U[2,4,400] |
| F36 | II.11.28 | $\theta$ | $1+n\alpha/(1-(n\alpha/3))$ | U[0,1,400] |
| F37 | II.27.18 | $E_{den}$ | $\epsilon Ef^2$ | U[2,4,400] |
| F38 | II.38.14 | $mu_S$ | $Y/(2(1+\sigma))$ | U[2,4,400] |
| F39 | III.12.43 | $L$ | $n(h/(2\pi))$ | U[2,4,400] |
| F40 | II.37.1 | $E_n$ | $mom(1+chi)B$ | U[2,4,1000] |
| F41 | I.18.12 | $tau$ | $rFsin(\theta)$ | U[2,4,1000] |
| F42 | I.6.2b | $f$ | $exp(-((\theta-\theta1)/\sigma)^2/2)/(sqrt(2\pi)\sigma)$ | U[1,3,1000] |
| F43 | I.10.7 | $m$ | $m_0/sqrt(1-v^2/c^2)$ | $m_0$, $c$:U[3,5,1000] $v$:U[1,2,1000] |
| F44 | I.12.4 | $Ef$ | $q_1r/(4\pi\epsilon r^3)$ | U[2,4,1000] |
| F45 | I.14.3 | $U$ | $mgz$ | U[2,4,1000] |
| F46 | I.15.1 | $p$ | $m_0v/sqrt(1-v^2/c^2)$ | $m0$, $c$:U[3,5,1000] $v$:U[1,2,1000] |
| F47 | I.16.6 | $v_1$ | $(u+v)/(1+uv/c^2)$ | U[2,4,1000] |
| F48 | I.27.6 | $foc$ | $1/(1/d_1+n/d_2)$ | U[2,4,1000] |
| F49 | I.30.3 | $Int$ | $Int_0sin(n\theta/2)^2/sin(\theta/2)^2$ | U[2,4,1000] |
| F50 | I.30.5 | $\theta$ | $arcsin(\lambda/(nd))$ | $\lambda$ :U[1,2,1000] $d$, $n$:U[2,4,1000] |
| F51 | I.34.1 | $\omega$ | $\omega_0/(1-v/c)$ | c, $\omega_0$ :U[3,5,1000] v:U[1,2,1000] |
| F52 | I.34.14 | $\omega$ | $(1+v/c)/sqrt(1-v^2/c^2)\omega_0$ | $c$, $\omega_0$ :U[3,5,1000] $v$:U[1,2,1000] |
| F53 | I.37.4 | $Int$ | $I_1+I_2+2sqrt(I_1I_2)cos(\delta)$ | U[2,4,1000] |
| F54 | I.39.11 | $E_n$ | $1/(\gamma-1)prV$ | U[2,4,1000] |
| F55 | I.43.31 | $D$ | $mob_kb_T$ | U[2,4,1000] |
| F56 | I.47.23 | $c$ | $sqrt(\gamma pr/rho)$ | U[2,4,1000] |
| F57 | II.4.23 | $Volt$ | $q/(4\pi\epsilon r)$ | U[2,4,1000] |
| F58 | II.8.7 | $E_n$ | $3/5q^2/(4\pi\epsilon d)$ | U[2,4,1000] |
| F59 | II.10.9 | $Ef$ | $\sigma_{den}/\epsilon1/(1+chi)$ | U[2,4,1000] |
| F60 | II.13.23 | $rho_c$ | $rho_{c0}/sqrt(1-v^2/c^2)$ | $rho_{c0}$, $c$:U[3,5,1000] $v$:U[1,2,1000] |
| F61 | II.13.34 | $j$ | $rho_{c0}v/sqrt(1-v^2/c^2)$ | $rho_{c0}$, $c$:U[3,5,1000] $v$:U[1,2,1000] |
| F62 | II.27.16 | $flux$ | $\epsilon cEf^2$ | U[2,4,1000] |
| F63 | II.34.2a | $I$ | $qv/(2\pi r)$ | U[2,4,1000] |
| F64 | II.34.2 | $mom$ | $qvr/2$ | U[2,4,1000] |
| F65 | II.34.29a | $mom$ | $qh/(4\pi m)$ | U[2,4,1000] |
| F66 | III.7.38 | $\omega$ | $2momB/(h/(2\pi))$ | U[2,4,1000] |
| F67 | III.8.54 | $prob$ | $sin(E_nt/(h/(2\pi)))^2$ | U[1,2,1000] |
| F68 | III.15.12 | $E_n$ | $2U(1-cos(kd))$ | U[2,4,1000] |
| F69 | II.15.4 | $E_n$ | $-momBcos(\theta)$ | U[2,4,1000] |
| F70 | II.15.5 | $E_n$ | $-p_dE_fcos(\theta)$ | U[2,4,1000] |
| F71 | I.18.14 | $L$ | $mrvsin(\theta)$ | U[2,4,4000] |

**Table 3: Penn Machine Learning Benchmarks(PMLB).**

| FileNumber | FileName | Samples | Variables | Task |
|---|---|---|---|---|
| F72 | 210_cloud | 108 | 5 | regression |
| F73 | 519_vinnie | 380 | 2 | regression |
| F74 | 573_cpu_act | 1000 | 21 | regression |
| F75 | 1027_ESL | 488 | 4 | regression |
| F76 | 1028_SWD | 1000 | 10 | regression |
| F77 | 1029_LEV | 1000 | 4 | regression |
| F78 | analcatdata_boxing1 | 120 | 3 | classification |
| F79 | car-evaluation | 1000 | 21 | classification |
| F80 | wine_quality_white | 1000 | 11 | classification |
| F81 | towerData | 1000 | 25 | regression |

**Table 4: Fitness Metrics**

| Kinds | Function | TaylorGP | | GPLearn | | FFX | | GSGP | | BSR | | LR | | KR | | RF | | SVM | | XGBoost | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE | CR | RMSE |
| SRB | F1 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2650 | 0.0% | .0023 | 0.0% | .0011 | 0.0% | .1839 | 0.0% | .1963 | 0.0% | .1226 | 0.0% | .0962 | 0.0% | .0008 |
| | F2 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2730 | 0.0% | .0004 | 0.0% | .0004 | 0.0% | .0371 | 0.0% | .0407 | 0.0% | .0515 | 0.0% | .0751 | 0.0% | .0014 |
| | F3 | **100.0%** | **.0000** | 0.0% | .0285 | 0.0% | .2973 | 0.0% | .1966 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | 1.0412 | 0.0% | 2.0636 | 0.0% | 8.7351 | 0.0% | .0015 |
| | F4 | **0.0%** | **.0000** | **0.0%** | .2189 | **0.0%** | .2620 | **0.0%** | .1641 | **0.0%** | .0006 | **0.0%** | .3308 | **0.0%** | 1.1220 | **0.0%** | .1975 | **0.0%** | .1207 | **0.0%** | .0009 |
| | F5 | **100.0%** | **.0000** | 0.0% | .1267 | 0.0% | .2233 | 0.0% | .0066 | 0.0% | .0106 | 0.0% | .8329 | 0.0% | .4767 | 0.0% | .6471 | 0.0% | .5646 | 0.0% | .0009 |
| | F6 | **100.0%** | **.0000** | 0.0% | .5840 | 0.0% | .1887 | 0.0% | .0051 | 3.3% | .0089 | 0.0% | .6777 | 0.0% | .4043 | 0.0% | .3615 | 0.0% | .5594 | 0.0% | .0012 |
| | F7 | **100.0%** | **.0000** | 0.0% | .2741 | 0.0% | .2518 | 26.7% | .0023 | 93.3% | .0002 | 0.0% | .6353 | 0.0% | .2515 | 0.0% | .3047 | 0.0% | .2207 | 0.0% | .0007 |
| | F8 | **100.0%** | **.0000** | 0.0% | .3495 | 0.0% | .2223 | 60.0% | .0008 | **100.0%** | **.0000** | 0.0% | .3693 | 0.0% | .1798 | 0.0% | .2191 | 0.0% | .2142 | 0.0% | .0011 |
| | F9 | **100.0%** | **.0000** | 0.0% | .0487 | 0.0% | .3376 | 0.0% | .0033 | 0.0% | .0004 | 0.0% | .0529 | 0.0% | .0549 | 0.0% | .0346 | 0.0% | .0537 | 0.0% | .0009 |
| | F10 | **100.0%** | **.0000** | 0.0% | .1503 | 0.0% | .3168 | 30.0% | .0037 | 33.3% | .0015 | 0.0% | .1440 | 0.0% | .1190 | 0.0% | .0575 | 0.0% | .0676 | 0.0% | .0012 |
| | F11 | **100.0%** | **.0000** | 0.0% | .1525 | 0.0% | .3478 | 0.0% | .0078 | **100.0%** | **.0000** | 0.0% | .1656 | 0.0% | .1718 | 0.0% | .0918 | 0.0% | .0752 | 0.0% | .0010 |
| | F12 | 3.3% | .0022 | 0.0% | .3177 | 0.0% | .3543 | 0.0% | .0044 | **100.0%** | **.0000** | 0.0% | .2112 | 0.0% | .1833 | 0.0% | .1118 | 0.0% | .0815 | 0.0% | .0011 |
| | F13 | **100.0%** | **.0000** | 73.3% | .4512 | 0.0% | .1846 | 0.0% | 3.6371 | 33.3% | 1.1589 | 0.0% | 21.0820 | 0.0% | 6.0679 | 0.0% | 4.0784 | 0.0% | 22.7293 | 0.0% | .0875 |
| | F14 | **0.0%** | .0206 | **0.0%** | .3290 | **0.0%** | .2093 | **0.0%** | .0136 | **0.0%** | .1126 | **0.0%** | .4062 | **0.0%** | .0672 | **0.0%** | .0402 | **0.0%** | .0695 | **0.0%** | **.0053** |
| | F15 | **100.0%** | **.0000** | 0.0% | .3309 | 0.0% | .2028 | 0.0% | .0248 | 0.0% | .0493 | 0.0% | .3579 | 0.0% | .1188 | 0.0% | .0493 | 0.0% | .0778 | 0.0% | .0040 |
| | F16 | 0.0% | .0219 | 0.0% | .3614 | 0.0% | .2713 | 0.0% | .0303 | **100.0%** | **.0000** | 0.0% | .4800 | 0.0% | .1365 | 0.0% | .1291 | 0.0% | .0613 | 0.0% | .0081 |
| | F17 | **100.0%** | **.0000** | 0.0% | .1279 | 0.0% | .2473 | 0.0% | .0096 | 0.0% | .0085 | 0.0% | .0879 | 0.0% | .0414 | 0.0% | .0320 | 0.0% | .0532 | 0.0% | .0058 |
| | F18 | 0.0% | .0028 | 0.0% | .3101 | 0.0% | .2454 | 0.0% | .0071 | **100.0%** | **.0000** | 0.0% | .2770 | 0.0% | .0289 | 0.0% | .0496 | 0.0% | .0635 | 0.0% | .0054 |
| | F19 | 0.0% | .0024 | 13.3% | .2261 | 0.0% | .2721 | 3.3% | .0086 | **100.0%** | **.0000** | 0.0% | .1611 | 0.0% | .0454 | 0.0% | .0421 | 0.0% | .0571 | 0.0% | .0038 |
| | F20 | 0.0% | .0396 | 0.0% | .0642 | 0.0% | .1687 | **3.3%** | .0715 | 0.0% | .1058 | 0.0% | 1.3504 | 0.0% | .2706 | 0.0% | .2488 | 0.0% | .3687 | 0.0% | **.0077** |
| | F21 | 0.0% | **.0000** | 0.0% | .0394 | 0.0% | .1256 | **3.3%** | .0012 | 0.0% | .0022 | 0.0% | .0533 | 0.0% | .0190 | 0.0% | .0048 | 0.0% | .0287 | 0.0% | .0018 |
| | F22 | 0.0% | .0001 | 0.0% | .4750 | 0.0% | .1861 | 3.3% | .0078 | **100.0%** | **.0000** | 0.0% | .1052 | 0.0% | .0666 | 0.0% | .0401 | 0.0% | .0502 | 0.0% | .0062 |
| | F23 | **0.0%** | **.0050** | **0.0%** | .1827 | **0.0%** | .0958 | **0.0%** | .0189 | **0.0%** | .1298 | **0.0%** | .2734 | **0.0%** | .1461 | **0.0%** | .0388 | **0.0%** | .0406 | **0.0%** | .0057 |
| best | | **16** | **16** | 5 | 2 | 3 | 0 | 5 | 0 | 11 | 8 | 4 | 1 | 3 | 0 | 3 | 0 | 3 | 0 | 3 | 2 |
| FSRB | F24 | 0.0% | .0008 | 0.0% | .0560 | 0.0% | .3044 | 0.0% | .0001 | **13.3%** | **.0001** | 0.0% | .0212 | 0.0% | .0283 | 0.0% | .0113 | 0.0% | .0771 | 0.0% | .0011 |
| | F25 | **0.0%** | **.0001** | **0.0%** | .0246 | **0.0%** | .1937 | **0.0%** | .0006 | **0.0%** | .0054 | **0.0%** | .0167 | **0.0%** | .0038 | **0.0%** | .0026 | **0.0%** | .0343 | **0.0%** | .0010 |
| | F26 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2363 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | 1.4143 | 0.0% | .0086 | 0.0% | .3157 | 0.0% | .3371 | 0.0% | .0157 |
| | F27 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2265 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | 1.4301 | 0.0% | .0090 | 0.0% | .3248 | 0.0% | .3430 | 0.0% | .0158 |
| | F28 | **100.0%** | **.0000** | 53.3% | .1140 | 0.0% | .2257 | 6.7% | .2939 | **100.0%** | **.0000** | 0.0% | 4.8804 | 0.0% | .0025 | 0.0% | .8526 | 0.0% | 2.1924 | 0.0% | .0339 |
| | F29 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1817 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .3584 | 0.0% | .0906 | 0.0% | .0690 | 0.0% | .0799 | 0.0% | .0052 |
| | F30 | 0.0% | .0070 | 0.0% | .2547 | 0.0% | .1709 | 0.0% | .0127 | **3.3%** | .0125 | 0.0% | .2095 | 0.0% | .0374 | 0.0% | .0218 | 0.0% | .0660 | 0.0% | **.0036** |
| | F31 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1810 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .3685 | 0.0% | .0858 | 0.0% | .0685 | 0.0% | .0856 | 0.0% | .0053 |
| | F32 | **100.0%** | **.0000** | 0.0% | .0080 | 0.0% | .2283 | 0.0% | .0182 | **100.0%** | **.0000** | 0.0% | .2293 | 0.0% | .0014 | 0.0% | .0514 | 0.0% | .0660 | 0.0% | .0047 |
| | F33 | **100.0%** | **.0000** | 16.7% | .0017 | 0.0% | .2307 | 13.3% | .0163 | **100.0%** | **.0000** | 0.0% | 2.1527 | 0.0% | .0136 | 0.0% | .4842 | 0.0% | .6682 | 0.0% | .0202 |
| | F34 | 0.0% | .0004 | 0.0% | .0348 | 0.0% | .1672 | 0.0% | .0006 | **100.0%** | **.0000** | 0.0% | .0363 | 0.0% | .0128 | 0.0% | .0055 | 0.0% | .0888 | 0.0% | .0011 |
| | F35 | **100.0%** | **.0000** | 46.7% | .1284 | 0.0% | .2278 | 10.0% | .1321 | **100.0%** | **.0000** | 0.0% | 4.8270 | 0.0% | .0025 | 0.0% | .9328 | 0.0% | 2.4628 | 0.0% | .0333 |
| | F36 | 0.0% | **.0000** | 0.0% | .2302 | 0.0% | .2178 | 0.0% | .0030 | **3.3%** | .0002 | 0.0% | .1287 | 0.0% | .0302 | 0.0% | .0233 | 0.0% | .0521 | 0.0% | .0035 |
| | F37 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2238 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | 9.5658 | 0.0% | .0051 | 0.0% | 1.7310 | 0.0% | 8.4967 | 0.0% | .0491 |
| | F38 | 0.0% | **.0001** | 0.0% | .1666 | 0.0% | .1995 | 6.7% | .0015 | **36.7%** | .0006 | 0.0% | .0687 | 0.0% | .0108 | 0.0% | .0161 | 0.0% | .0602 | 0.0% | .0030 |
| | F39 | **100.0%** | **.0000** | 0.0% | .0081 | 0.0% | .2307 | 0.0% | .0218 | **100.0%** | **.0000** | 0.0% | .2295 | 0.0% | .0014 | 0.0% | .0519 | 0.0% | .0662 | 0.0% | .0049 |
| | F40 | 90.0% | .0002 | 90.0% | .0276 | 0.0% | .1917 | 6.7% | .0086 | **100.0%** | **.0000** | 0.0% | .2616 | 0.0% | .0201 | 0.0% | .2134 | 0.0% | .0815 | 0.0% | .0125 |
| | F41 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1923 | 0.0% | .0195 | **100.0%** | **.0000** | 0.0% | .1400 | 0.0% | .0564 | 0.0% | .0597 | 0.0% | .0511 | 0.0% | .0057 |
| | F42 | **0.0%** | .0020 | **0.0%** | .0215 | **0.0%** | .2736 | **0.0%** | **.0004** | **0.0%** | .0018 | **0.0%** | .0051 | **0.0%** | .0050 | **0.0%** | .0014 | **0.0%** | .0256 | **0.0%** | .0005 |
| | F43 | **0.0%** | .0083 | **0.0%** | .2578 | **0.0%** | .2149 | **0.0%** | **.0033** | **0.0%** | .0167 | **0.0%** | .0895 | **0.0%** | .0138 | **0.0%** | .0190 | **0.0%** | .0638 | **0.0%** | .0039 |
| | F44 | 0.0% | **.0000** | 0.0% | .0070 | 0.0% | .1796 | 0.0% | .0002 | **6.7%** | .0009 | 0.0% | .0024 | 0.0% | .0014 | 0.0% | .0008 | 0.0% | .0143 | 0.0% | .0004 |
| | F45 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1932 | 80.0% | .0028 | **100.0%** | **.0000** | 0.0% | .2215 | 0.0% | .0172 | 0.0% | .1632 | 0.0% | .0665 | 0.0% | .0106 |
| | F46 | **0.0%** | .0091 | **0.0%** | .2578 | **0.0%** | .2183 | **0.0%** | **.0033** | **0.0%** | .0168 | **0.0%** | .0887 | **0.0%** | .0143 | **0.0%** | .0192 | **0.0%** | .0641 | **0.0%** | .0039 |
| | F47 | **0.0%** | **.0010** | **0.0%** | .0220 | **0.0%** | .2776 | **0.0%** | .0017 | **0.0%** | .0147 | **0.0%** | .0310 | **0.0%** | .0106 | **0.0%** | .0052 | **0.0%** | .0504 | **0.0%** | .0017 |
| | F48 | **3.3%** | **.0002** | **3.3%** | .0834 | 0.0% | .1882 | **3.3%** | .0012 | **3.3%** | .0078 | 0.0% | .0142 | 0.0% | .0066 | 0.0% | .0086 | 0.0% | .0458 | 0.0% | .0022 |
| | F49 | **0.0%** | .0518 | **0.0%** | .8525 | **0.0%** | .2279 | **0.0%** | .0404 | **0.0%** | .1000 | **0.0%** | .2555 | **0.0%** | .1114 | **0.0%** | .0605 | **0.0%** | .0559 | **0.0%** | **.0079** |
| | F50 | **0.0%** | .0008 | **0.0%** | .0396 | **0.0%** | .1870 | **0.0%** | **.0003** | **0.0%** | .0004 | **0.0%** | .0075 | **0.0%** | .0044 | **0.0%** | .0039 | **0.0%** | .0518 | **0.0%** | .0014 |
| | F51 | **100.0%** | **.0000** | 73.3% | .0748 | 0.0% | .1902 | 10.0% | .0049 | 20.0% | .0210 | 0.0% | .0758 | 0.0% | .0231 | 0.0% | .0403 | 0.0% | .0596 | 0.0% | .0039 |
| | F52 | **0.0%** | **.0003** | **0.0%** | .2010 | **0.0%** | .2007 | **0.0%** | .0033 | **0.0%** | .0141 | **0.0%** | .0440 | **0.0%** | .0159 | **0.0%** | .0274 | **0.0%** | .0665 | **0.0%** | .0039 |
| | F53 | **0.0%** | **.0005** | **0.0%** | .3903 | **0.0%** | .2456 | **0.0%** | .0186 | **0.0%** | .0105 | **0.0%** | .0946 | **0.0%** | .0607 | **0.0%** | .0359 | **0.0%** | .0606 | **0.0%** | .0051 |
| | F54 | **13.3%** | **.0001** | 0.0% | .2937 | 0.0% | .1806 | 0.0% | .0048 | 0.0% | .0037 | 0.0% | .0647 | 0.0% | .0272 | 0.0% | .0417 | 0.0% | .0448 | 0.0% | .0046 |
| | F55 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1909 | 86.7% | .0016 | **100.0%** | **.0000** | 0.0% | .2201 | 0.0% | .0178 | 0.0% | .1605 | 0.0% | .0635 | 0.0% | .0108 |
| | F56 | **100.0%** | **.0000** | 93.3% | .0067 | 0.0% | .1829 | 0.0% | .0010 | 0.0% | .0070 | 0.0% | .0133 | 0.0% | .0108 | 0.0% | .0142 | 0.0% | .0394 | 0.0% | .0027 |
| | F57 | 0.0% | **.0000** | 0.0% | .0116 | 0.0% | .1643 | 0.0% | .0003 | **80.0%** | .0002 | 0.0% | .0036 | 0.0% | .0016 | 0.0% | .0015 | 0.0% | .0232 | 0.0% | .0008 |
| | F58 | **20.0%** | **.0000** | 0.0% | .0162 | 0.0% | .1764 | 0.0% | .0004 | 10.0% | .0015 | 0.0% | .0044 | 0.0% | .0015 | 0.0% | .0018 | 0.0% | .0306 | 0.0% | .0006 |
| | F59 | **56.7%** | **.0000** | 0.0% | .0689 | 0.0% | .1810 | 3.3% | .0008 | 6.7% | .0056 | 0.0% | .0154 | 0.0% | .0091 | 0.0% | .0079 | 0.0% | .0533 | 0.0% | .0023 |
| | F60 | **0.0%** | **.0004** | **0.0%** | .1609 | **0.0%** | .2430 | **0.0%** | .0011 | **0.0%** | .0082 | **0.0%** | .0155 | **0.0%** | .0096 | **0.0%** | .0093 | **0.0%** | .0508 | **0.0%** | .0023 |
| | F61 | **0.0%** | .0090 | **0.0%** | .2635 | **0.0%** | .2197 | **0.0%** | **.0032** | **0.0%** | .0166 | **0.0%** | .0886 | **0.0%** | .0139 | **0.0%** | .0196 | **0.0%** | .0646 | **0.0%** | .0039 |
| | F62 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .1988 | 53.3% | .0186 | **100.0%** | **.0000** | 0.0% | .7969 | 0.0% | .1435 | 0.0% | .4133 | 0.0% | .2370 | 0.0% | .0293 |
| | F63 | 33.3% | .0000 | 0.0% | .0717 | 0.0% | .1785 | 0.0% | .0017 | **100.0%** | **.0000** | 0.0% | .0167 | 0.0% | .0037 | 0.0% | .0085 | 0.0% | .0508 | 0.0% | .0028 |
| | F64 | **100.0%** | **.0000** | 13.3% | .3832 | 0.0% | .1920 | 0.0% | .0137 | **100.0%** | **.0000** | 0.0% | .1113 | 0.0% | .0086 | 0.0% | .0794 | 0.0% | .0520 | 0.0% | .0062 |
| | F65 | 43.3% | .0000 | 0.0% | .0557 | 0.0% | .1712 | 0.0% | .0022 | **100.0%** | **.0000** | 0.0% | .0204 | 0.0% | .0034 | 0.0% | .0069 | 0.0% | .0616 | 0.0% | .0022 |
| | F66 | 0.0% | .0213 | 0.0% | .4185 | 0.0% | .1805 | 0.0% | .1470 | **100.0%** | **.0000** | 0.0% | .8053 | 0.0% | .2694 | 0.0% | .5194 | 0.0% | .3044 | 0.0% | .0258 |
| | F67 | 0.0% | **.0002** | 0.0% | .0034 | 0.0% | .1589 | **3.3%** | .0002 | 0.0% | .0007 | 0.0% | .0017 | 0.0% | .0006 | 0.0% | .0005 | 0.0% | .0098 | 0.0% | .0003 |
| | F68 | 0.0% | .0010 | 0.0% | .4232 | 0.0% | .1785 | 0.0% | .0145 | **100.0%** | **.0000** | 0.0% | .1147 | 0.0% | .0976 | 0.0% | .0674 | 0.0% | .0507 | 0.0% | .0064 |
| | F69 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2414 | 0.0% | .0185 | **100.0%** | **.0000** | 0.0% | .1715 | 0.0% | .0352 | 0.0% | .0511 | 0.0% | .0577 | 0.0% | .0052 |
| | F70 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .2405 | 0.0% | .0179 | **100.0%** | **.0000** | 0.0% | .1696 | 0.0% | .0358 | 0.0% | .0504 | 0.0% | .0570 | 0.0% | .0052 |
| | F71 | 96.7% | .0002 | 90.0% | .0237 | 0.0% | .2350 | 0.0% | .3014 | **100.0%** | **.0000** | 0.0% | .9990 | 0.0% | .1960 | 0.0% | .1456 | 0.0% | .1701 | 0.0% | .0238 |
| best | | 34 | **33** | 23 | 11 | 11 | 0 | 18 | 10 | **42** | 25 | 11 | 0 | 11 | 0 | 11 | 0 | 11 | 0 | 11 | 2 |
| PMLB | F72 | **0.0%** | .2481 | **0.0%** | .3688 | **0.0%** | .1678 | **0.0%** | .1228 | **0.0%** | .2856 | **0.0%** | .3301 | **0.0%** | .3623 | **0.0%** | .4857 | **0.0%** | .4146 | **0.0%** | **.0014** |
| | F73 | **0.0%** | 1.2169 | **0.0%** | 1.3312 | **0.0%** | **.2063** | **0.0%** | 1.1944 | **0.0%** | 1.5121 | **0.0%** | 1.5429 | **0.0%** | 1.5339 | **0.0%** | 1.7134 | **0.0%** | 1.6835 | **0.0%** | 1.4172 |
| | F74 | **0.0%** | 3.2050 | **0.0%** | 4.4539 | **0.0%** | .1844 | **0.0%** | 11.4619 | **0.0%** | 6.4230 | **0.0%** | 8.9662 | **0.0%** | 14.7675 | **0.0%** | 2.8844 | **0.0%** | 14.8341 | **0.0%** | **.0869** |
| | F75 | **0.0%** | .4316 | **0.0%** | .5287 | **0.0%** | **.1770** | **0.0%** | .3300 | **0.0%** | .5126 | **0.0%** | .5217 | **0.0%** | .5495 | **0.0%** | .5751 | **0.0%** | .4748 | **0.0%** | .3541 |
| | F76 | **0.0%** | .5305 | **0.0%** | .6163 | **0.0%** | **.2702** | **0.0%** | .4354 | **0.0%** | .6406 | **0.0%** | .6249 | **0.0%** | .6319 | **0.0%** | .6469 | **0.0%** | .6038 | **0.0%** | .5625 |
| | F77 | 0.0% | .5359 | 0.0% | .7612 | 0.0% | **.2380** | **3.3%** | .4000 | 0.0% | .6279 | 0.0% | .6419 | 0.0% | .6306 | 0.0% | .6671 | 0.0% | .6231 | 0.0% | .5859 |
| | F78 | **0.0%** | .2457 | **0.0%** | .3440 | **0.0%** | .4811 | **0.0%** | .2252 | **0.0%** | .3491 | **0.0%** | .4483 | **0.0%** | .4479 | **0.0%** | .3813 | **0.0%** | .4368 | **0.0%** | **.0058** |
| | F79 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .4716 | 0.0% | .0335 | **100.0%** | **.0000** | **100.0%** | **.0000** | 0.0% | .0082 | **100.0%** | **.0000** | 0.0% | .0985 | 0.0% | .0000 |
| | F80 | **0.0%** | .6331 | **0.0%** | .6690 | **0.0%** | .1561 | **0.0%** | .5122 | **0.0%** | .7848 | **0.0%** | .7822 | **0.0%** | .7923 | **0.0%** | .6766 | **0.0%** | .8713 | **0.0%** | **.0360** |
| | F81 | **0.0%** | 15.1959 | **0.0%** | 32.7227 | **0.0%** | **.1916** | **0.0%** | 25.3951 | **0.0%** | 45.7915 | **0.0%** | 28.3523 | **0.0%** | 30.6675 | **0.0%** | 23.4327 | **0.0%** | 83.1058 | **0.0%** | .8736 |
| best | | **9** | 1 | **9** | 1 | 8 | **5** | **9** | 0 | **9** | 1 | **9** | 1 | 8 | 0 | **9** | 1 | 8 | 0 | 8 | 4 |

CR represents the proportion of finding the correct result whose fitness computed by RMSE is less than 1e-5.

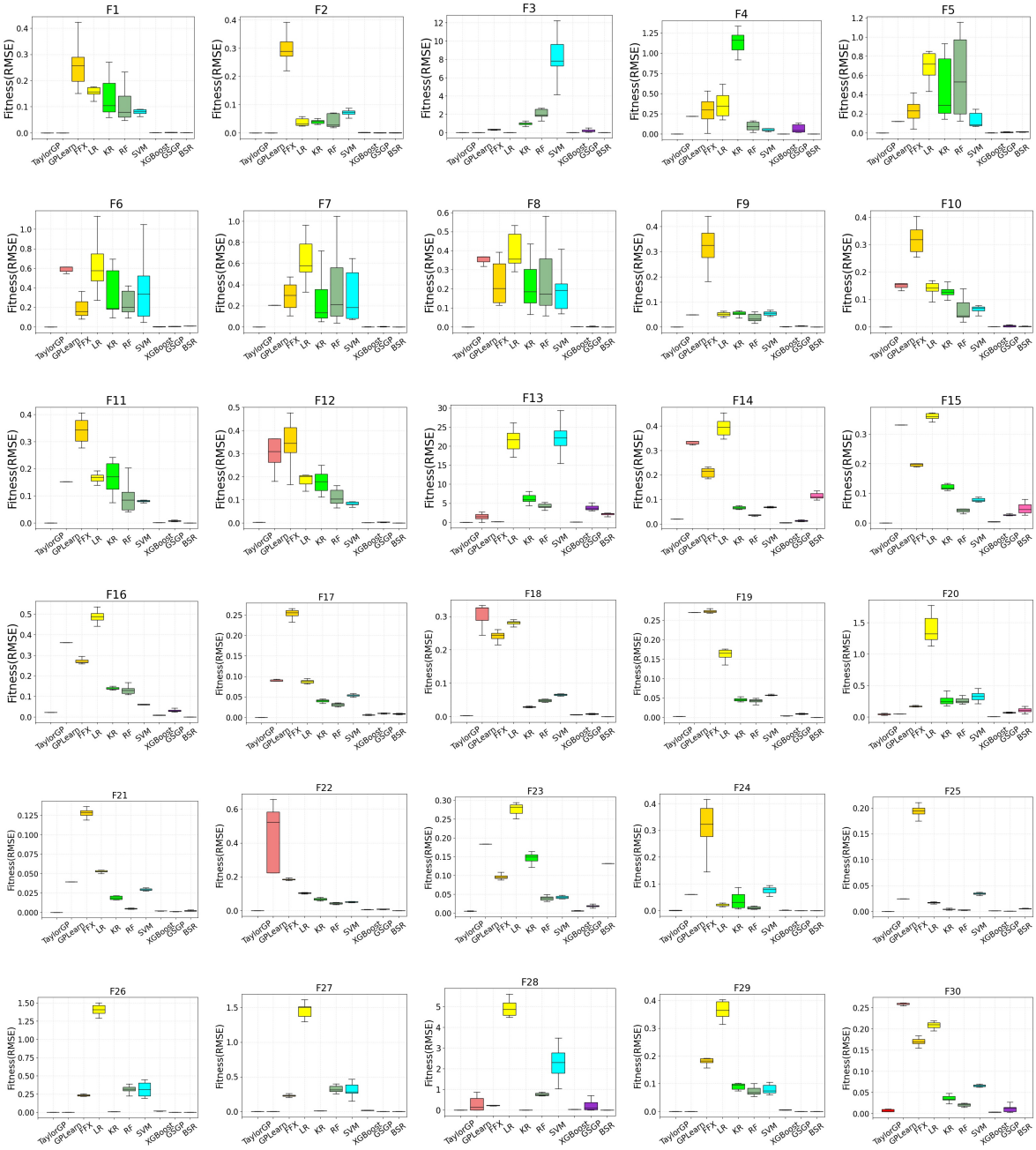


**Figure 1: Fitness comparison. The RMSE results on the benchmarks F1-F30.**

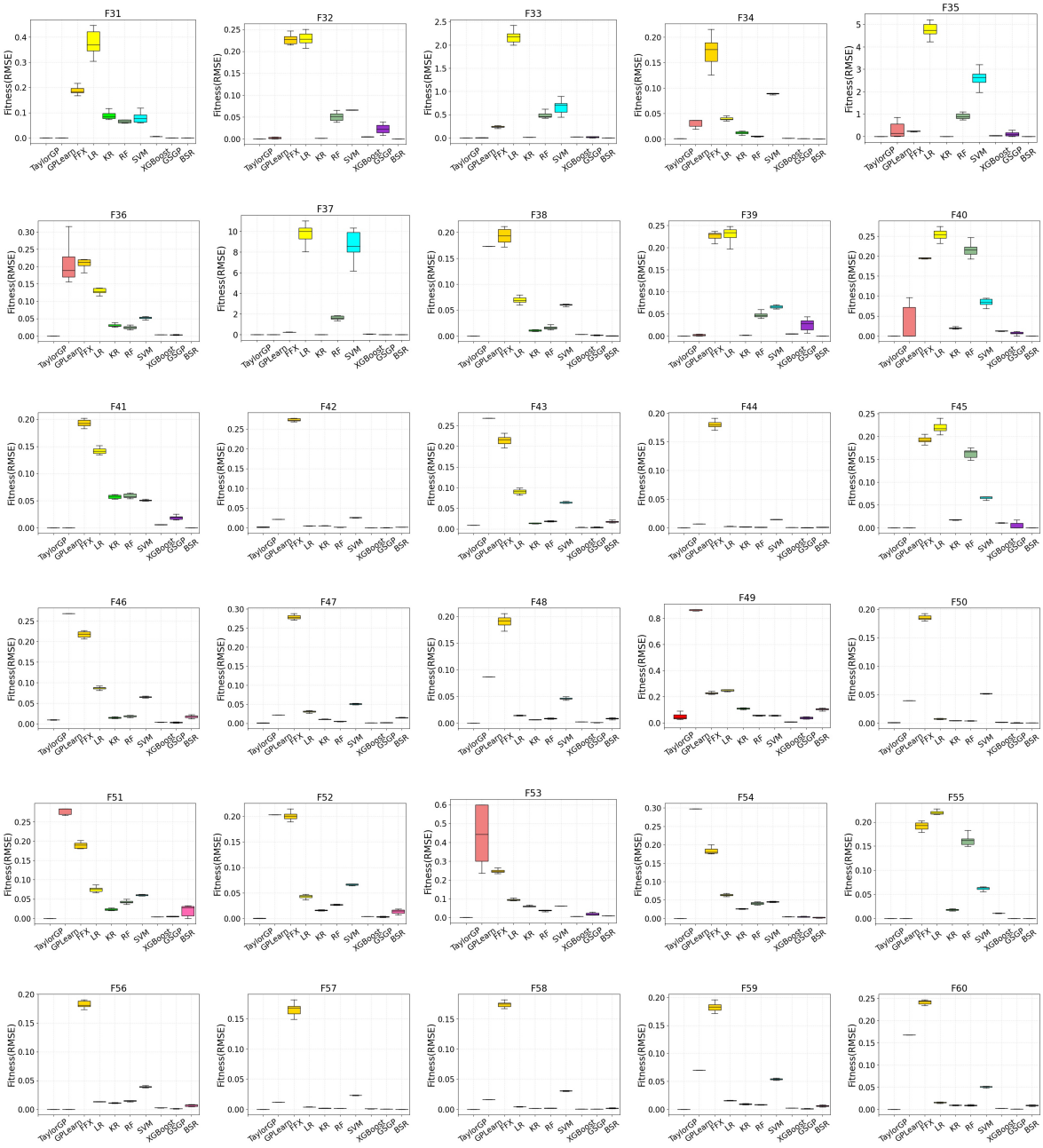


**Figure 2: Fitness comparison. The RMSE results on the benchmarks F31-F60.**

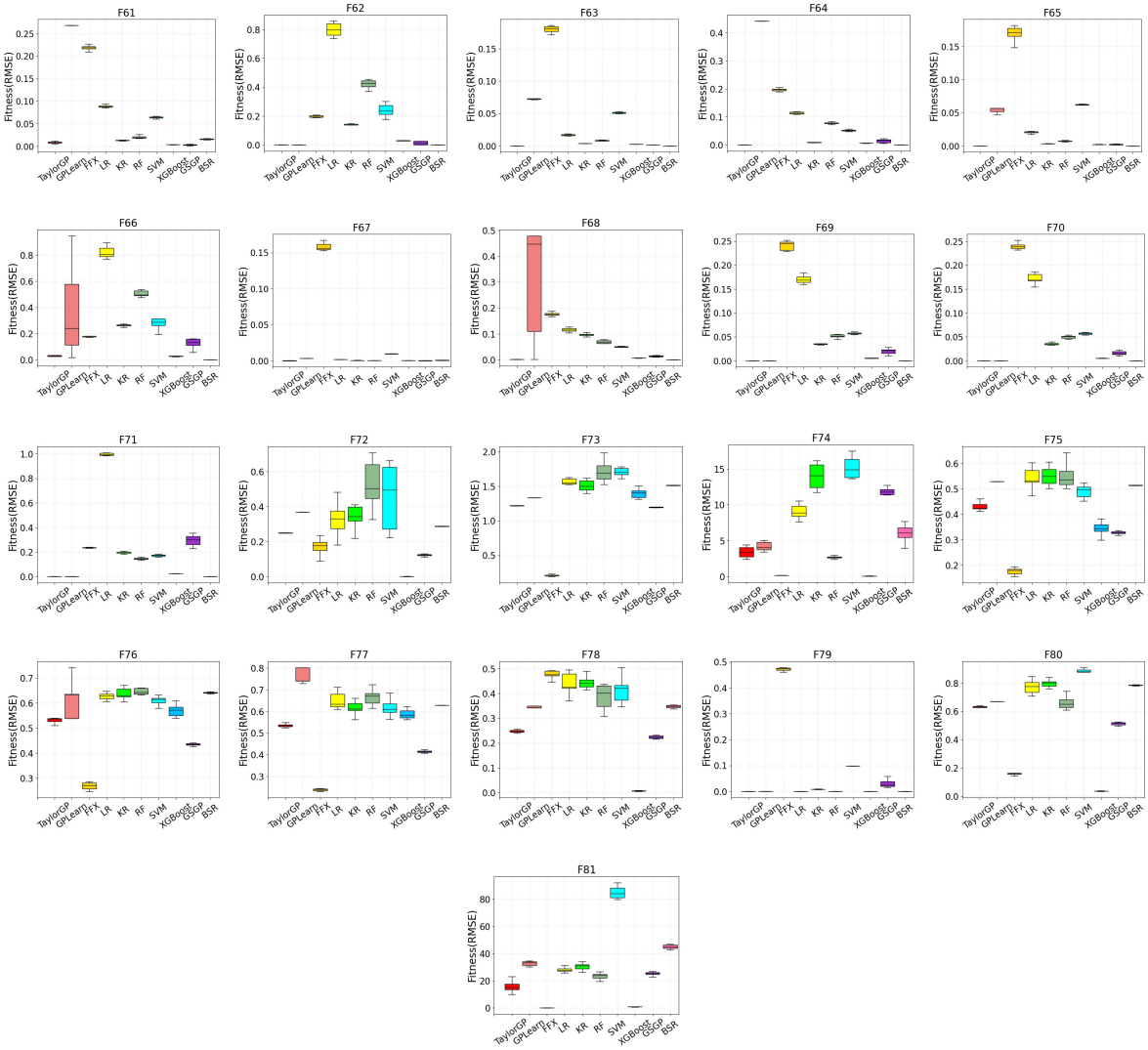


**Figure 3: Fitness comparison. The RMSE results on the benchmarks F61-F81.**

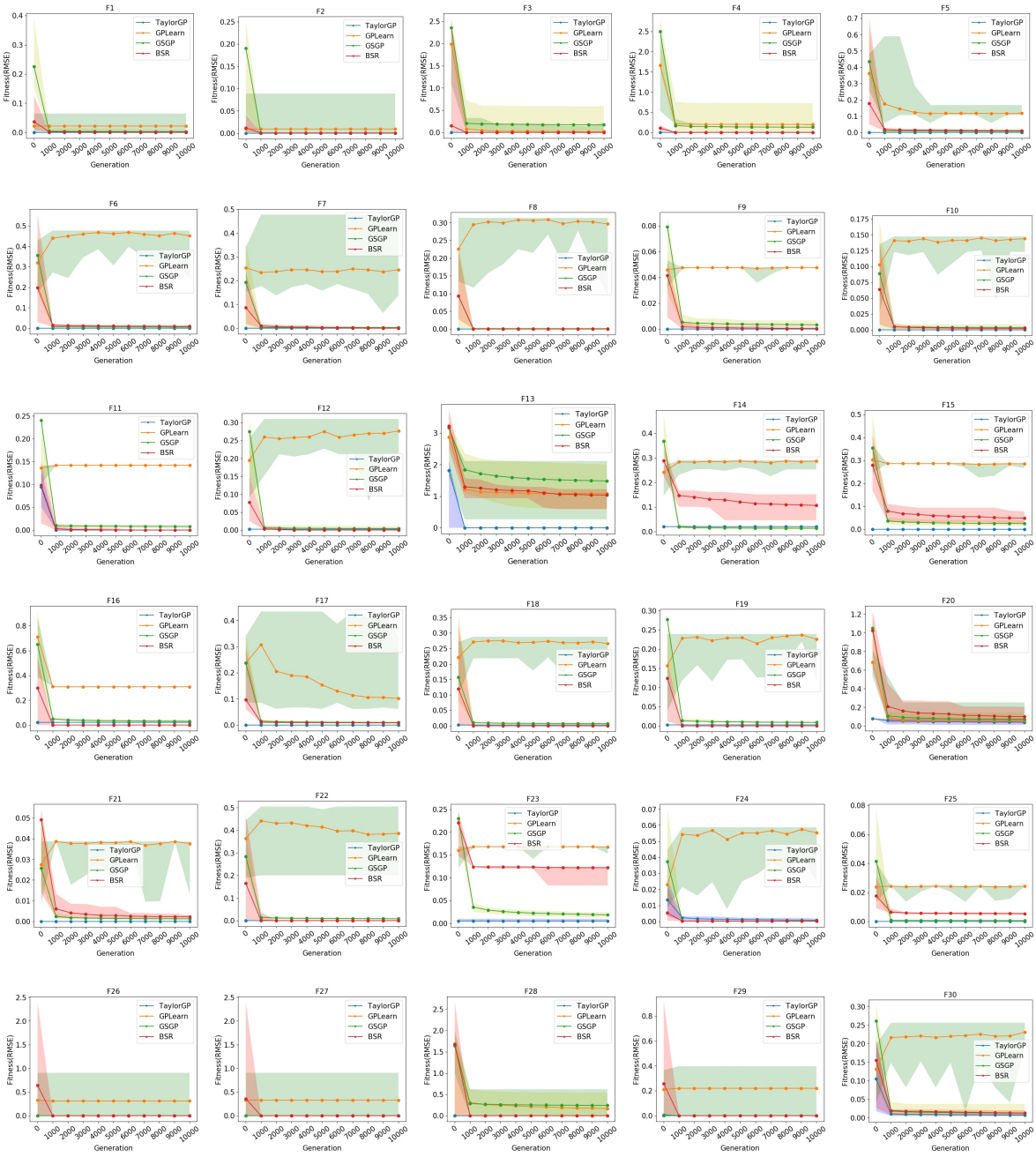


**Figure 4: Comparison of convergence. The fitness convergence curve of four algorithms on the benchmarks F1-F30.**

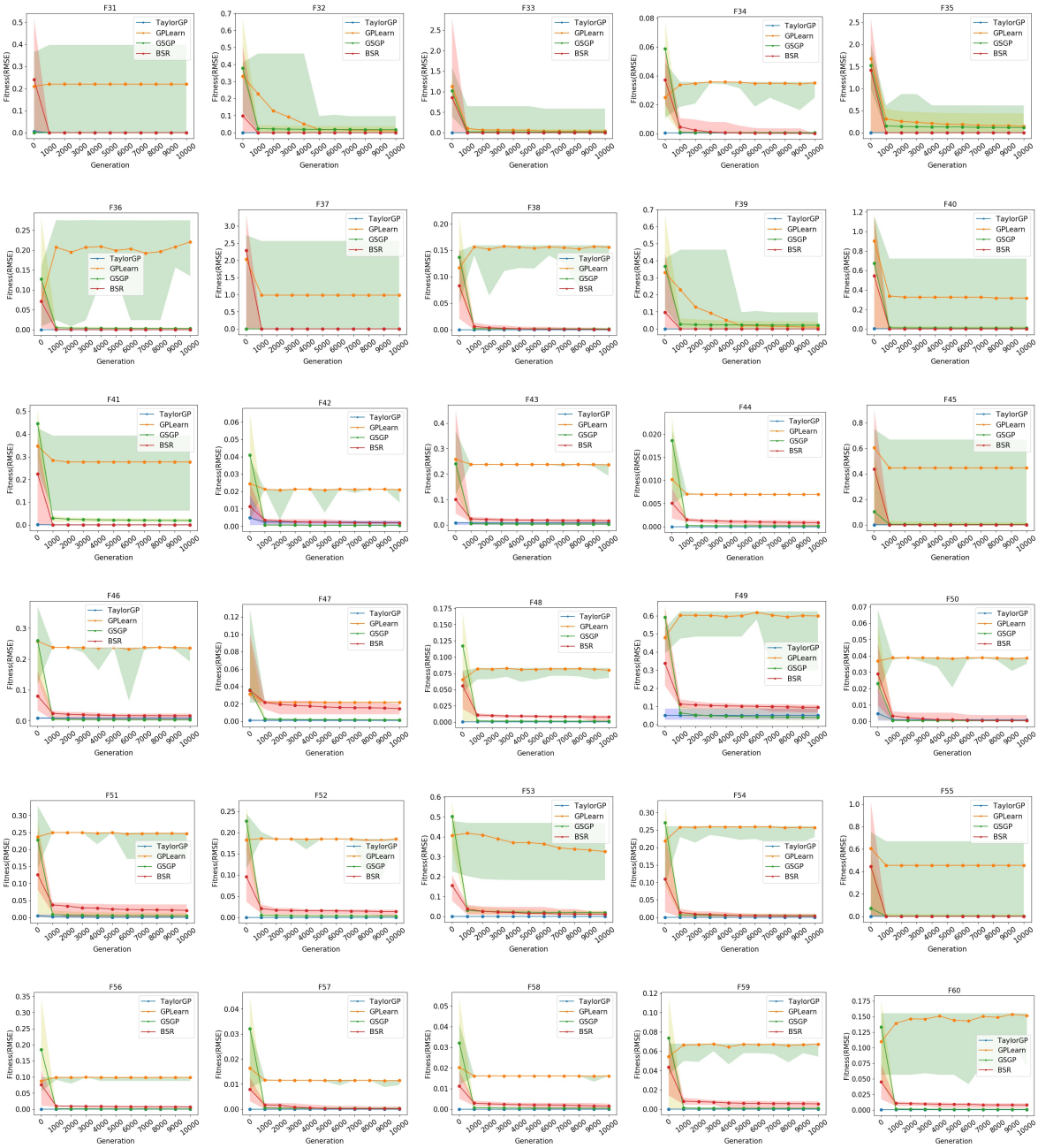


**Figure 5: Comparison of convergence. The fitness convergence curve of four algorithms on the benchmarks F31-F60.**

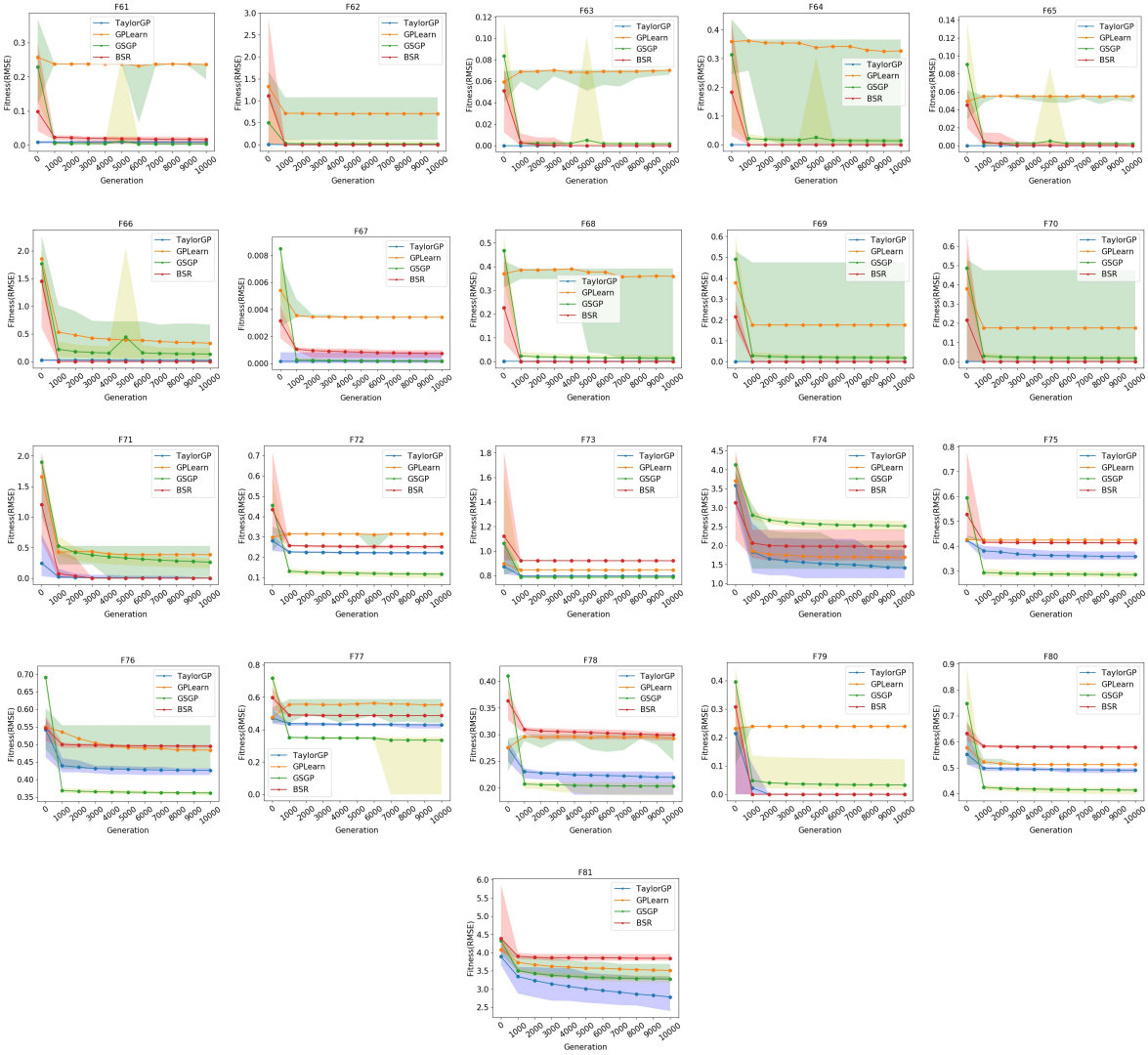


**Figure 6: Comparison of convergence. The fitness convergence curve of four algorithms on the benchmarks F61-F81.**