FinSage V2 智能体输入输出详解

1. 专家智能体 (Expert Agents)

所有专家继承自 `BaseExpert`，共享相同的输入输出结构。

1.1 StockExpert (股票专家)

输入:

```
market_data: Dict[str, Any]
#  :
{
    "SPY": {"close": 450.25, "open": 448.0, "high": 451.0, "low": 447.5, "volume": 85000000, "change_pc
    "QQQ": {"close": 380.50, "open": 378.0, "high": 382.0, "low": 377.0, "volume": 45000000, "change_pc
    "AAPL": {...},
    "NVDA": {...},
}

news_data: List[Dict]
#  :
[
    {"title": "Fed signals rate cut", "published": "2024-10-15", "sentiment": "positive", "symbols": ["
    {"title": "Tech earnings beat expectations", "sentiment": "positive", "symbols": ["QQQ", "AAPL"]},
]

technical_indicators: Dict[str, Any]
#  :
{
    "SPY": {"rsi_14": 58.5, "macd": 2.3, "macd_signal": 1.8, "sma_20": 445.0, "sma_50": 440.0},
    "QQQ": {"rsi_14": 62.0, "macd": 3.1, "macd_signal": 2.5, "sma_20": 375.0, "sma_50": 368.0},
}

macro_data: Optional[Dict[str, Any]]  #
#  :
{
    "vix": 18.5,
    "sp500_pe": 22.3,
    "market_breadth": 0.65,
}
```

输出:

```
ExpertReport(
    expert_name="Stock Expert",
    asset_class="stocks",
    timestamp="2024-10-15T14:30:00",
    recommendations=[
        ExpertRecommendation(
            asset_class="stocks",
            symbol="SPY",
            action=Action.BUY_50,  # V2 : SHORT_25/50/75/100
            confidence=0.75,
            target_weight=0.12,   #
            reasoning="Strong momentum with Fed support",
```

```
            market_view={"trend": "bullish", "momentum": "positive"},
            risk_assessment={"volatility_risk": 0.15, "downside_risk": 0.08},
        ),
        ExpertRecommendation(
            asset_class="stocks",
            symbol="NVDA",
            action=Action.BUY_75,
            confidence=0.80,
            target_weight=0.10,
            reasoning="AI demand driving growth",
            market_view={"trend": "bullish", "sector": "technology"},
            risk_assessment={"volatility_risk": 0.25, "downside_risk": 0.12},
        ),
    ],
    overall_view="bullish",  # bullish / bearish / neutral
    sector_allocation={"SPY": 0.30, "QQQ": 0.25, "NVDA": 0.25, "AAPL": 0.20},
    key_factors=["Fed dovish stance", "Strong earnings", "AI momentum"],
)
```

1.2 BondExpert (债券专家)

输入:

```
market_data: Dict[str, Any]
#  :
{
    "TLT": {"close": 92.45, "change_pct": -0.85, "yield": 4.85},
    "IEF": {"close": 95.20, "change_pct": -0.42, "yield": 4.25},
    "SHY": {"close": 82.10, "change_pct": -0.05, "yield": 5.10},
    "rates": {
        "fed_funds": 5.25,
        "treasury_2y": 4.95,
        "treasury_10y": 4.65,
        "treasury_30y": 4.85,
        "spread_2s10s": -30,  #   bps
    }
}

news_data: List[Dict]
#  :
[
    {"title": "FOMC minutes reveal hawkish stance", "sentiment": "negative"},
    {"title": "Inflation remains sticky", "sentiment": "negative"},
]

technical_indicators: Dict[str, Any]
#  :
{
    "TLT": {"rsi_14": 35.2, "macd": -1.25, "trend": "downtrend"},
}
```

输出:

```
ExpertReport(
```

```
    expert_name="Bond Expert",
    asset_class="bonds",
    timestamp="2024-10-15T14:30:00",
    recommendations=[
        ExpertRecommendation(
            asset_class="bonds",
            symbol="TLT",
            action=Action.SHORT_50,  # V2 :
            confidence=0.70,
            target_weight=-0.08,    #    =
            reasoning="Rising rates pressure long-duration bonds",
            market_view={
                "rate_view": "hawkish",
                "duration_preference": "short",
                "credit_view": "neutral",
            },
            risk_assessment={"duration_risk": 0.35, "credit_risk": 0.05},
        ),
        ExpertRecommendation(
            asset_class="bonds",
            symbol="SHY",
            action=Action.BUY_25,
            confidence=0.65,
            target_weight=0.05,
            reasoning="Short duration safer in rising rate environment",
            market_view={"rate_view": "hawkish", "duration_preference": "short"},
            risk_assessment={"duration_risk": 0.08, "credit_risk": 0.02},
        ),
    ],
    overall_view="bearish",
    sector_allocation={"TLT": -0.40, "SHY": 0.35, "IEF": 0.25},
    key_factors=["Fed hawkish stance", "Inverted yield curve", "Rising long-term rates"],
)
```

1.3 CommodityExpert (商品专家)

输入:

```
market_data: Dict[str, Any]
#  :
{
    "GLD": {"close": 185.50, "change_pct": 0.65, "volume": 12000000},
    "SLV": {"close": 21.80, "change_pct": 0.92, "volume": 8000000},
    "USO": {"close": 72.30, "change_pct": -1.25, "volume": 8500000},
    "commodities": {
        "gold_spot": 1985.50,
        "silver_spot": 23.45,
        "crude_wti": 82.50,
        "natural_gas": 2.85,
        "copper": 3.75,
    }
}
```

```
news_data: List[Dict]
#  :
[
    {"title": "OPEC+ considers production cuts", "sentiment": "positive", "symbols": ["USO"]},
    {"title": "Gold rises on safe-haven demand", "sentiment": "positive", "symbols": ["GLD"]},
]

macro_data: Dict[str, Any]
#  :
{
    "dollar_index": 105.5,
    "inflation_expectation": 2.8,
    "real_rates": 1.5,
}
```

输出:

```
ExpertReport(
    expert_name="Commodity Expert",
    asset_class="commodities",
    timestamp="2024-10-15T14:30:00",
    recommendations=[
        ExpertRecommendation(
            asset_class="commodities",
            symbol="GLD",
            action=Action.BUY_50,
            confidence=0.72,
            target_weight=0.08,
            reasoning="Safe haven demand amid market uncertainty",
            market_view={"gold_view": "bullish", "dollar_impact": "neutral"},
            risk_assessment={"volatility_risk": 0.12, "currency_risk": 0.08},
        ),
        ExpertRecommendation(
            asset_class="commodities",
            symbol="USO",
            action=Action.SHORT_25,  # V2:
            confidence=0.55,
            target_weight=-0.03,    #
            reasoning="Demand concerns outweigh OPEC cuts",
            market_view={"oil_view": "bearish", "supply_demand": "oversupply"},
            risk_assessment={"volatility_risk": 0.25, "geopolitical_risk": 0.30},
        ),
    ],
    overall_view="neutral",
    sector_allocation={"GLD": 0.50, "SLV": 0.20, "USO": -0.15, "DBA": 0.15},
    key_factors=["Dollar strength", "Safe haven flows", "Oil demand uncertainty"],
)
```

1.4 REITsExpert (房地产信托专家)

输入:

```
market_data: Dict[str, Any]
#  :
```

```
{
    "VNQ": {"close": 82.50, "change_pct": -0.95, "dividend_yield": 4.25},
    "DLR": {"close": 125.80, "change_pct": 0.45, "dividend_yield": 3.85, "sector": "data_center"},
    "EQIX": {"close": 780.50, "change_pct": 0.62, "dividend_yield": 2.10, "sector": "data_center"},
    "rates": {
        "mortgage_30y": 7.25,
        "treasury_10y": 4.65,
    }
}

news_data: List[Dict]
#  :
[
    {"title": "Office vacancy rates hit record high", "sentiment": "negative", "sector": "office"},
    {"title": "Data center demand surges on AI boom", "sentiment": "positive", "sector": "data_center"}
]
```

输出:

```
ExpertReport(
    expert_name="REITs Expert",
    asset_class="reits",
    timestamp="2024-10-15T14:30:00",
    recommendations=[
        ExpertRecommendation(
            asset_class="reits",
            symbol="VNQ",
            action=Action.SHORT_25,  # V2:   REITs
            confidence=0.60,
            target_weight=-0.03,
            reasoning="Rising rates and office vacancy concerns",
            market_view={"sector_view": "bearish", "rate_sensitivity": "high"},
            risk_assessment={"rate_risk": 0.35, "vacancy_risk": 0.25},
        ),
        ExpertRecommendation(
            asset_class="reits",
            symbol="DLR",
            action=Action.BUY_50,
            confidence=0.75,
            target_weight=0.05,
            reasoning="Data center demand driven by AI infrastructure",
            market_view={"sector_view": "bullish", "growth_driver": "AI/cloud"},
            risk_assessment={"rate_risk": 0.20, "tech_dependency": 0.15},
        ),
    ],
    overall_view="neutral",
    sector_allocation={"DLR": 0.45, "EQIX": 0.35, "VNQ": -0.10, "IYR": -0.10},
    key_factors=["High interest rates", "Office sector weakness", "Data center strength"],
)
```

1.5 CryptoExpert (加密货币专家)

输入:

```
market_data: Dict[str, Any]
#  :
{
    "BTC-USD": {
        "close": 42500.00,
        "change_pct": 2.35,
        "volume_24h": 28000000000,
        "market_cap": 830000000000,
        "dominance": 52.5,
    },
    "ETH-USD": {
        "close": 2250.00,
        "change_pct": 3.15,
        "volume_24h": 15000000000,
        "gas_price": 25,
    },
    "market_metrics": {
        "total_market_cap": 1580000000000,
        "fear_greed_index": 65,
        "btc_dominance": 52.5,
    }
}

news_data: List[Dict]
#  :
[
    {"title": "Bitcoin ETF approval speculation intensifies", "sentiment": "positive"},
    {"title": "Ethereum Shanghai upgrade successful", "sentiment": "positive"},
]

on_chain_data: Optional[Dict]  #
#  :
{
    "btc_exchange_netflow": -15000,  #  =
    "eth_staking_ratio": 0.22,
    "whale_activity": "accumulating",
}
```

输出:

```
ExpertReport(
    expert_name="Crypto Expert",
    asset_class="crypto",
    timestamp="2024-10-15T14:30:00",
    recommendations=[
        ExpertRecommendation(
            asset_class="crypto",
            symbol="BTC-USD",
            action=Action.BUY_75,
            confidence=0.70,
            target_weight=0.04,
            reasoning="ETF approval momentum, exchange outflows bullish",
            market_view={"trend": "bullish", "catalyst": "ETF_approval", "on_chain": "accumulation"},
            risk_assessment={"volatility_risk": 0.45, "regulatory_risk": 0.25},
        ),
```

```python
        ExpertRecommendation(
            asset_class="crypto",
            symbol="ETH-USD",
            action=Action.BUY_50,
            confidence=0.65,
            target_weight=0.03,
            reasoning="Network upgrade success, growing staking",
            market_view={"trend": "bullish", "network_health": "strong"},
            risk_assessment={"volatility_risk": 0.50, "smart_contract_risk": 0.15},
        ),
    ],
    overall_view="bullish",
    sector_allocation={"BTC-USD": 0.60, "ETH-USD": 0.40},
    key_factors=["Bitcoin ETF catalyst", "Institutional accumulation", "Network upgrades"],
)
```

---

2. Portfolio Manager (组合管理器)

输入:

```python
expert_reports: Dict[str, ExpertReport]
#  :
{
    "stocks": ExpertReport(...),    #   StockExpert
    "bonds": ExpertReport(...),     #   BondExpert
    "commodities": ExpertReport(...),
    "reits": ExpertReport(...),
    "crypto": ExpertReport(...),
}

portfolio_state: PortfolioState
#     (  4 )

risk_constraints: Dict
#  :
{
    "max_single_asset": 0.15,
    "max_asset_class": 0.50,
    "max_short_exposure": 0.30,  # V2 :
    "target_volatility": 0.12,
    "max_drawdown": 0.15,
}

allocation_bounds: Dict[str, Dict]
#  :
{
    "stocks": {"min": 0.30, "max": 0.50},
    "bonds": {"min": -0.20, "max": 0.35},  # V2: min
    "commodities": {"min": -0.10, "max": 0.25},
    "reits": {"min": -0.05, "max": 0.15},
    "crypto": {"min": 0.00, "max": 0.10},
    "cash": {"min": 0.05, "max": 0.20},
```

```
}
```

输出:

```
target_allocation: Dict[str, float]
#   (V2:     ):
{
    "SPY": 0.12,
    "QQQ": 0.10,
    "NVDA": 0.08,
    "AAPL": 0.06,
    "TLT": -0.08,    #
    "IEF": -0.04,    #
    "SHY": 0.05,
    "GLD": 0.08,
    "USO": -0.03,    #
    "DLR": 0.05,
    "BTC-USD": 0.04,
    "ETH-USD": 0.03,
    "cash": 0.10,
}

trade_orders: List[TradeOrder]
#  :
[
    TradeOrder(symbol="TLT", action="SHORT", shares=100, target_weight=-0.08),
    TradeOrder(symbol="SPY", action="BUY", shares=50, target_weight=0.12),
    TradeOrder(symbol="USO", action="SHORT", shares=200, target_weight=-0.03),
]

optimization_report: Dict
#  :
{
    "expected_return": 0.085,
    "expected_volatility": 0.118,
    "sharpe_ratio": 0.72,
    "max_drawdown_estimate": 0.12,
    "gross_exposure": 1.15,    # V2 :
    "net_exposure": 0.85,      # V2 :
    "short_exposure": 0.15,    # V2 :
}
```

---

3. Risk Controller (风控控制器)

输入:

```
proposed_allocation: Dict[str, float]
#   Portfolio Manager     (  )
#  :
{
    "SPY": 0.15,
    "TLT": -0.10,   #
    "GLD": 0.08,
```

```
}

portfolio_state: PortfolioState
#

historical_returns: pd.DataFrame
#      (252 )

risk_params: Dict
#   (V2     ):
{
    "max_single_asset": 0.15,
    "max_asset_class": 0.50,
    "max_var_95": 0.03,
    "max_drawdown": 0.15,
    # V2
    "max_short_single": 0.10,    #
    "max_total_short": 0.30,     #
    "margin_requirement": 0.50,   #
}
```

输出:

```
adjusted_allocation: Dict[str, float]
#
#  :
{
    "SPY": 0.15,      #
    "TLT": -0.08,     #  -0.10  -0.08 (     )
    "GLD": 0.08,      #
}

risk_report: Dict
#  :
{
    "checks_passed": True,
    "violations": [],
    "warnings": [
        {
            "type": "SHORT_CONCENTRATION",
            "message": "TLT short reduced from 10% to 8%",
            "original": -0.10,
            "adjusted": -0.08,
        }
    ],
    "risk_metrics": {
        "portfolio_var_95": 0.025,
        "expected_shortfall": 0.032,
        "gross_exposure": 1.12,
        "net_exposure": 0.88,
        "short_exposure": 0.12,
        "margin_utilization": 0.24,  # V2
        "diversification_score": 0.85,
    },
    # V2 :
```

```
    "short_checks": {
        "single_short_ok": True,      #    <= 10%
        "total_short_ok": True,       #    <= 30%
        "margin_ok": True,            #
        "borrow_available": True,     #
        "short_squeeze_risk": "low",  #
    },
    "stress_tests": {
        "market_crash_10pct": -0.065,
        "rate_spike_100bps": 0.015,   # V2:
        "volatility_spike": -0.042,
    },
}
```

---

4. Trading Environment (交易环境)

4.1 MultiAssetEnv

输入:

```
config: FinSageConfig
#

market_data_stream: Dict
#
#   :
{
    "date": "2024-10-15",
    "prices": {
        "SPY": 450.25,
        "TLT": 92.45,
        "GLD": 185.50,
    },
    "volumes": {...},
    "news": [...],
}

expert_weights: Dict
#
#   :
{
    "SPY": {"action": "BUY_50%", "confidence": 0.75},
    "TLT": {"action": "SHORT_50%", "confidence": 0.70},  # V2
    "GLD": {"action": "BUY_25%", "confidence": 0.65},
}
```

step() 输出:

```
observation: Dict
#

reward: float
#
```

```
done: bool
#

info: Dict
#  :
{
    "date": "2024-10-15",
    "portfolio_value": 1005230.50,
    "daily_return": 0.0052,
    "trades_executed": [
        {"symbol": "TLT", "action": "SHORT", "shares": 100, "price": 92.45},
        {"symbol": "SPY", "action": "BUY", "shares": 25, "price": 450.25},
    ],
    "positions": {
        "SPY": {"shares": 225, "value": 101306.25, "weight": 0.101},
        "TLT": {"shares": -100, "value": -9245.00, "weight": -0.009},  # V2:
        "GLD": {"shares": 150, "value": 27825.00, "weight": 0.028},
    },
    # V2
    "short_metrics": {
        "short_market_value": 9245.00,
        "margin_used": 4622.50,
        "borrowing_cost_daily": 0.51,
    },
}
```

4.2 PortfolioState

Position 结构:

```
@dataclass
class Position:
    symbol: str
    shares: float           # V2 :  = ,  =
    avg_cost: float
    current_price: float
    asset_class: str

    # V2
    @property
    def is_short(self) -> bool:
        return self.shares < 0

    @property
    def market_value(self) -> float:
        return self.shares * self.current_price  #

    @property
    def unrealized_pnl(self) -> float:
        if self.is_short:
            #  :   =
            return abs(self.shares) * (self.avg_cost - self.current_price)
        else:
```

```python
            #   :     =
            return self.shares * (self.current_price - self.avg_cost)

    @property
    def margin_requirement(self) -> float:
        if self.is_short:
            return abs(self.market_value) * 0.5  # 50%
        return 0.0
```

PortfolioState 结构:

```python
@dataclass
class PortfolioState:
    initial_capital: float = 1_000_000.0
    cash: float = 1_000_000.0
    positions: Dict[str, Position] = field(default_factory=dict)
    trade_history: List[Dict] = field(default_factory=list)
    value_history: List[Dict] = field(default_factory=list)

    # V2
    short_borrow_rate: float = 0.02   #      2%
    short_margin_ratio: float = 0.5   #       50%

    # V2
    @property
    def long_market_value(self) -> float:
        """   """
        return sum(pos.market_value for pos in self.positions.values() if not pos.is_short)

    @property
    def short_market_value(self) -> float:
        """    ( )"""
        return sum(pos.market_value for pos in self.positions.values() if pos.is_short)

    @property
    def gross_exposure(self) -> float:
        """   = |  | + |  |"""
        return self.long_market_value + abs(self.short_market_value)

    @property
    def net_exposure(self) -> float:
        """   =    - |  |"""
        return self.long_market_value - abs(self.short_market_value)

    @property
    def short_margin_required(self) -> float:
        """    """
        return abs(self.short_market_value) * self.short_margin_ratio
```

---

5. V2 做空机制

5.1 Action 枚举 (13-Action Space)

```
class Action(Enum):
    #    (V2 )
    SHORT_100 = "SHORT_100%"    # multiplier = -1.0
    SHORT_75 = "SHORT_75%"      # multiplier = -0.75
    SHORT_50 = "SHORT_50%"      # multiplier = -0.5
    SHORT_25 = "SHORT_25%"      # multiplier = -0.25

    #  /
    SELL_100 = "SELL_100%"      # multiplier = 0.0
    SELL_75 = "SELL_75%"        # multiplier = 0.25
    SELL_50 = "SELL_50%"        # multiplier = 0.5
    SELL_25 = "SELL_25%"        # multiplier = 0.75

    #
    HOLD = "HOLD"               # multiplier = 1.0

    #  /
    BUY_25 = "BUY_25%"          # multiplier = 1.25
    BUY_50 = "BUY_50%"          # multiplier = 1.5
    BUY_75 = "BUY_75%"          # multiplier = 1.75
    BUY_100 = "BUY_100%"        # multiplier = 2.0
```

5.2 做空交易类型

交易类型	触发条件	说明
`SHORT`	shares < 0, 无现有仓位	开新空仓
`ADD_SHORT`	shares < 0, 有空头仓位	加空仓
`COVER_SHORT`	shares > 0, 有空头仓位	平空仓
`SELL_AND_SHORT`	shares < 0, 有多头仓位, is_short=True	先卖后空
`COVER_AND_BUY`	shares > 平空所需, 有空头仓位	先平空后做多

5.3 空头盈亏计算

```
PnL = shares × (current_price - avg_cost)
          →

PnL = |shares| × (avg_cost - current_price)
          →
```

5.4 保证金和借股成本

项目	数值	公式
保证金比例	50%	`margin = |short_value| × 0.5`
借股费率	2% 年化	`daily_cost = |short_value| × 0.02 / 365`

6. 完整系统架构图

6.1 系统总览

```
                    FinSage V2 Multi-Agent System
                        (       )


                          DATA LAYER (  )


   FMP API        Yahoo Fin       News API       Technical        Macro
  (Prices)        (Backup)       (Sentiment)     Indicators       Data




                        DataProvider ( )
                        market_data, news,
                        technical, macro




                      EXPERT LAYER (  )


  StockExpert        BondExpert         CommodityExpert     REITsExpert

 Input:             Input:             Input:             Input:
 - prices           - prices           - prices           - prices
 - news             - rates            - commodities      - mortgage rate
 - technicals       - FOMC news        - dollar index     - vacancy news
 - VIX              - inflation        - geopolitics      - sector news

 Output:            Output:            Output:            Output:
 ExpertReport       ExpertReport       ExpertReport       ExpertReport
 - BUY/HOLD/SELL    - BUY/HOLD/SELL    - BUY/HOLD/SELL    - BUY/HOLD/SELL
 - SHORT (V2)       - SHORT (V2)       - SHORT (V2)       - SHORT (V2)


                   CryptoExpert

           Input: prices, on-chain, news
           Output: ExpertReport
```

```
                         5  ExpertReport
                          recommendations[]
                          SHORT   (V2)


                  DECISION LAYER (  )


                   Portfolio Manager (   )

Input:                                  Output:
  expert_reports (5   )          target_allocation
  portfolio_state (  )                SPY: 0.12
  risk_constraints                         TLT: -0.08  ← V2:   =
  allocation_bounds                        GLD: 0.08
                                              ...
                                       trade_orders
Process:                               optimization_report
1.                                 gross_exposure: 1.15
2.   action_multiplier                  net_exposure: 0.85
   SHORT_50% → -0.5                          short_exposure: 0.15
3.


                         target_allocation
                         (    )


                   Risk Controller (   )

Input:                                  Output:
  proposed_allocation                    adjusted_allocation
  portfolio_state                         (    )
  historical_returns
  risk_params                            risk_report
      max_single_asset: 0.15                 checks_passed
      max_short_single: 0.10 (V2)            violations
      max_total_short: 0.30 (V2)             risk_metrics
      margin_requirement: 0.50                   VaR_95
                                                   margin_utilization
Checks:                                            short_exposure
                                   short_checks (V2)
        (V2)                           single_short_ok
       (V2)                              total_short_ok
       (V2)                              margin_ok
```

```
  VaR



                           adjusted_allocation
                           (     )




                      EXECUTION LAYER (  )




                       MultiAssetEnv (  )


Input:                                    step() Output:
  config                                   observation (   )
  market_data_stream                       reward (  )
  adjusted_allocation                      done (  )
                                            info
                                               portfolio_value
_rebalance():                                  trades_executed
                                        positions
       (target < 0)                     short_metrics (V2)
     BUY/SELL/SHORT                              short_market_value
                                               margin_used
                                                    borrowing_cost_daily




                       PortfolioState (  )




                        Position ( )

  symbol: str        shares: float (= ,  = )
  avg_cost: float    current_price: float    asset_class: str

  V2  :
    is_short → shares < 0
    market_value → shares × price (  )
    unrealized_pnl →  : (price-cost)×shares
                       : (cost-price)×|shares| ←   =
    margin_requirement → |market_value| × 0.5 (  )


State:                                    V2   :
  cash                                     long_market_value (  )
  positions: Dict[str, Position]           short_market_value (  , )
  trade_history                            gross_exposure (  )
```

```
  value_history                        net_exposure (  )
  short_borrow_rate: 0.02 (V2)         short_margin_required
  short_margin_ratio: 0.5 (V2)

execute_trade()   :

  BUY          shares > 0,       /
  SELL         shares < 0,       /
  SHORT        shares < 0,         (V2)
  ADD_SHORT    shares < 0,        (V2)
  COVER_SHORT  shares > 0,        (V2)
  SELL_AND_SHORT            (V2)
  COVER_AND_BUY              (V2)
```

6.2 V2 做空数据流

```
                               BondExpert
                           "     "



                             ExpertRecommendation
                             symbol: "TLT"
                             action: SHORT_50%
                             confidence: 0.70
                             target_weight: -0.08



                               Portfolio Manager
                             action_multiplier = -0.5
                             weight = -0.5 × 0.7 × W
                             target: TLT = -0.08



                                Risk Controller
                              : -0.08 < -0.10
                             (    10%)
                              ! adjusted = -0.08



                                 MultiAssetEnv
```

```
target_weight < 0
is_short = True
shares =
```

```
PortfolioState.execute_trade
action = "SHORT"
 TLT →   →
Position(shares=-100)
```

```
TLT: shares = -100
avg_cost = $92.45
is_short = True
margin_req = $4,622.50
```

```
   $92→$87                        $92→$97

unrealized_pnl                      unrealized_pnl
= 100×(92-87)                       = 100×(92-97)
= +$500                          = -$500
```

6.3 13-Action Space 映射

```
                    13-Action Trading Space

   (V2 )

 -1.0   -0.75   -0.5   -0.25    0.0   0.25 0.5 0.75  1.0   1.25 1.5 1.75 2.0

SHORT  SHORT  SHORT  SHORT  SELL SELL SELL SELL HOLD BUY  BUY  BUY  BUY
100%   75%    50%    25%    100% 75%  50%  25%       25%  50%  75%  100%

                  0
```

```
 :
final_weight = base_weight × action_multiplier × confidence
```

```
:
     = 0.40
    TLT: SHORT_50%, confidence = 0.70

 action_multiplier = -0.5
 final_weight = 0.40 × (-0.5) × 0.70 = -0.14

 →   TLT    -14%
```